AFOTEC PROJECT 86-0167

NEXT GENERATION WEATHER RADAR (NEXRAD) INITIAL OPERATIONAL TEST AND EVALUATION PHASE II [IOT&E(2)]

FINAL REPORT (U)

DECEMBER 1989

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This report summarizes the Next Generation Weather Radar (NEXRAD) initial operational test and evaluation phase II (IOT&E(2)) results. NEXRAD is a joint Department of Commerce, Defense, and Transportation effort to develop and procure a doppler weather radar system to replace the present radar and as a major upgrade to existing capability. The ~~NEXRAD IOT&E(2)~~ had four purposes: evaluate the operational effectiveness and suitability of the preproduction NEXRAD; review deficiencies and enhancements documented during previous testing; identify deficiencies and enhancements not previously documented; and identify items to be addressed during follow-on operational test and evaluation. The NEXRAD Program Council will use the test results as an aid to exercising the full-scale production option and to identify deficiencies that need to be corrected before NEXRAD becomes fully operational. (Continued)

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NEXRAD was an effective aid in providing weather warning, weather advisory, and routine weather services support. However, the usefulness of velocity-based products was severely degraded during periods of widespread convective activity. In addition, reliability, maintainability, and availability problems, such as those associated with power transitions, PUP graphics processors, and the transmitter, severely detracted from mission capability. Software documentation and software support resource deficiencies produce a risk that the government may not be able to assume software support responsibilities at the appropriate time.

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AFOTEC PROJECT

86-0167

NEXT GENERATION WEATHER RADAR (NEXRAD)

INITIAL OPERATIONAL TEST AND EVALUATION PHASE II (IOT&E(2))

FINAL REPORT

DECEMBER 1989

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EXECUTIVE SUMMARY

1. An integrated, tridepartmental (Department of Commerce (DOC), Department of Defense (DOD), and Department of Transportation (DOT)) test team under the overall management of the Air Force Operational Test and Evaluation Center (AFOTEC) conducted the Initial Operational Test and Evaluation Phase II (IOT&E(2)) of the Next Generation Weather Radar (NEXRAD) system. The test team conducted IOT&E(2) between 6 March and 6 August 1989 at three test sites: Norman, Oklahoma; Tinker Air Force Base (AFB), Oklahoma; and Oklahoma City, Oklahoma. The purpose of IOT&E (2) was fourfold: to evaluate the operational effectiveness and suitability of the preproduction NEXRAD for DOC, DOD, and DOT to support a full-production decision; to review deficiencies and enhancements documented by the test team during IOT&E(1A) and IOT&E(1B); to identify deficiencies and enhancements not previously documented; and to identify items to be addressed during follow-on operational test and evaluation (FOT&E).

2. The NEXRAD system is a major upgrade of existing weather radar capabilities to support the weather-related missions of the DOC, DOD, and DOT. The NEXRAD system is designed to use Doppler radars to obtain storm intensity and quantitative information on wind structure within storms. During IOT&E(2), a single validation phase preproduction NEXRAD system, consisting of one Radar Data Acquisition (RDA) unit, one Radar Product Generation (RPG) unit, and four Principal User Processing (PUP) units, was tested. The RDA unit included a Doppler radar and the software required to perform signal processing, clutter suppression, control, error detection, and calibration. The RPG unit included all the hardware and software required for real-time generation, storage, and distribution of radar products for operational use and for overall NEXRAD system control, status monitoring, error detection, and data archiving. The PUP unit included all the hardware and software for the request, display, storage, and annotation of products. It also included the hardware and software for the control of the PUP, status monitoring, and data archiving.

3. This test, the second phase of the NEXRAD operational testing (IOT&E(2)), was conducted in two parts. Part A was a shared development test and evaluation (DT&E) and operational test and evaluation (OT&E) period. Part B was dedicated to OT&E. IOT&E(2) was based on 18 objectives (8 effectiveness, 7 suitability, and 3 combined) as identified in the approved IOT&E(2) test plan.

4. The evaluation of the operational effectiveness objectives relied on the opinion of the NEXRAD operators obtained through questionnaires. During the Operator Questionnaire administration, the operators provided two responses for each question. The first response, discussed in paragraphs 5a and 7 below, evaluated the system when it was operating disregarding system outages and was used to evaluate NEXRAD's effectiveness in comparison to the users' criteria. The second response, discussed in paragraph 5d, evaluated overall system performance including the impact of system outages and is provided as additional information.

a. Operations. NEXRAD met the operators' minimum operational requirements as an aid in providing weather warnings, advisories, and routine weather services support, primarily because of the accuracy and high resolution of reflectivity-based products. The capability to magnify and time-lapse storms in a color presentation was particularly effective. However, several deficiencies were identified. During widespread convective weather, the usefulness of the velocity-based products was severely degraded because they contained large areas of range-folded and incorrectly dealiased data. In addition, the operators did not find useful information in the layered-turbulence products. Use of the Unit Control Position and the PUP together resulted in a significant increase in operator workload. During severe weather situations, the radar often failed to recover automatically

from power transitions. In addition, test team specialists identified numerous deficiencies with planned agency operations training.

b. Logistics. The NEXRAD system did not meet the users' requirements for maintainability, fault isolation, and availability. In addition, the test team identified reliability problems with the preproduction transmitter, RPG, the graphics processors, and the optical disk drive units. Agency technicians were not able to maintain the system within the required repair time with the technical manuals, training, and primary fault isolation capability provided for IOT&E(2). The Preliminary Technical Manual set was incomplete and contained numerous errors making it inadequate for training and for maintaining the NEXRAD system. Training did not contain sufficient detail, did not interrelate functionality, and did not follow a logical plan; therefore, technicians did not develop the required skills to maintain NEXRAD.

c. Software. The documentation and source listings for the four computer program configuration items evaluated met the users' requirements. Software evaluators found individual source listings contained simple, expandable, modular code characteristics. However, problems were identified with the overall system software documentation. Software personnel were often unable to find or trace required information. Software training did not provide the required skills and procedures for software maintenance. Detailed agency plans for project and configuration management were incomplete and had not been finalized and approved. This may impact the government's ability to assume software support responsibilities at the appropriate time.

d. Overall Performance. When the overall performance of NEXRAD was considered, including the impact of system outages, the median questionnaire response of all the operators indicated that the system did not meet their requirements as an aid for providing weather warnings, weather advisories, and routine weather services. Most operators stated that NEXRAD was often not available to support these services because of PUP lockups, system outages, and problems with recovering automatically from power transitions. However, possibly because of their smaller area of weather support responsibilities, DOD median questionnaire responses indicated that the system met their minimum operational needs when the overall NEXRAD performance was considered.

5. The test team reported deficiencies and enhancements in accordance with Air Force Technical Order 00-35D-54. During the NEXRAD IOT&E(2), the test team validated and submitted 545 new service reports (SRs) to the Joint System Program Office; 486 were deficiencies and 59 were enhancements. Additionally, during this period the test team revalidated 87 deficiencies and 23 enhancements from the 355 SRs submitted during previously conducted IOT&Es. With regard to safety deficiencies, the test team identified 56 safety deficiencies, 9 of which were potentially life threatening or could cause severe injury or occupational illness.

6. The test team identified several items which should be addressed during follow-on operational test and evaluation (FOT&E). The three most significant items are described below. For operations, because of limitations identified in paragraph 2.2.2a, FOT&E should address the responsiveness of a production-model NEXRAD in an operational, multiple-user environment during a significant weather season. For logistics, organizational-level maintenance should be performed on a production-model NEXRAD using validated and verified technical manuals and the integrated logistics support infrastructure. For software, the operational support facility should generate and test a new software version release well in advance of support management responsibility transfer (SMRT) to include adding, deleting, and changing functionality within the RDA, RPG, and PUP.

7. In summary, NEXRAD was an effective aid in providing weather warning, weather advisory, and routine weather services support. However, the usefulness of velocity-based products was severely degraded during periods of widespread convective activity. In addition, reliability, maintainability, and availability problems, such as those associated with power transitions, PUP graphics processors, and the transmitter, severely detracted from mission capability. Software documentation and software support resource deficiencies produce a risk that the government may not be able to assume software support responsibilities at the appropriate time.

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TABLES

FIGURES

ABBREVIATIONS

AFB	Air Force Base
AFOTEC	Air Force Operational Test and Evaluation Center
AFOTECP	AFOTEC pamphlet
A_o	operational availability
AP	anomalous propagation
BIT	built-in test
BWS	base weather station
C5	computer program product specification
CBT	computer-based training
CDRL	contract deliverable requirements list
CIUG	Communications Interface User's Guide
CND	cannot duplicate
COI	critical operational issue
CPCI	computer program configuration item
CPU	central processing unit
CRMP	Computer Resources Management Plan
CSSP	Contractor Support Services Plan
CWSU	center weather service unit
DOC	Department of Commerce
DOD	Department of Defense
DOT	Department of Transportation
DRAWG	Data Reduction and Analysis Working Group
DSE	deputy for software evaluation
DT&E	development test and evaluation
EMC	electromagnetic compatibility
FAA	Federal Aviation Administration
FAR	false alarm rate
FMH	Federal Meteorological Handbook
FOT&E	follow-on operational test and evaluation
FTM	Free Text Message
GMT	Greenwich mean time
HQ	headquarters
ICD	interface control document
ILSP	Integrated Logistics Support Plan
IOT&E	initial operational test and evaluation
JSPO	Joint System Program Office
km	kilometer
LRU	line-replaceable unit
M	mean downtime
MCC	maintenance control console

ABBREVIATIONS (continued)

Mcf	mean downtime for critical failure
MDC	maintenance data collection
MIC	meteorologist in charge
MOA	memorandum of agreement
MOE	measure of effectiveness
MTBCF	mean time between critical failure
MTBF	mean time between failure
MTBM	mean time between maintenance
MTT	mean time to troubleshoot
MTTR	mean time to repair
NEXRAD	Next Generation Weather Radar
nm	nautical mile
NPC	NEXRAD Program Council
NSSL	National Severe Storms Laboratory
NTR	NEXRAD Technical Requirements
OJT	on-the-job training
OKC	Oklahoma City
OSF	operational support facility
OT&E	operational test and evaluation
PDL	program design language
PFI	primary fault isolation
PMI	preventive maintenance inspection
POD	probability of detection
PTM	Preliminary Technical Manual
PUES	principal user external system
PUP	Principal User Processing
RCM	Radar-Coded Message
RDA	Radar Data Acquisition
RDASOT	Radar Data Acquisition System Operational Test
RM&A	reliability, maintainability, and availability
RPG	Radar Product Generation
RPS	routine product set
SAM	School of Aerospace Medicine
SDD	supporting data document
SMP	Software Management Plan
SMRT	support management responsibility transfer
SOP	standard operating procedure
SR	service report
SSR	software support resources
SUQ	Software Usability Questionnaire
TAFB	Tinker Air Force Base
TEMP	test and evaluation master plan
TO	technical order
TOP	test operating procedure
UCP	unit control position

ABBREVIATIONS (continued)

UFI	unconfirmed fault isolation
URC	unit radar committee
VAD	Velocity Azimuth Display
VDD	version description document
VIL	Vertically Integrated Liquid Water
WER	Weak Echo Region
WSFO	Weather Service Forecast Office
WSOM	Weather Service operations manual
WSR	weather surveillance radar

SECTION I - PURPOSE AND BACKGROUND

1.0 OPERATIONAL TEST AND EVALUATION (OT&E) PURPOSE. An integrated, tridepartmental (Department of Commerce (DOC), Department of Defense (DOD), and Department of Transportation (DOT)) test team under the overall management of the Air Force Operational Test and Evaluation Center (AFOTEC) conducted the Initial Operational Test and Evaluation Phase II (IOT&E(2)) of the Next Generation Weather Radar (NEXRAD) system. The test team conducted IOT&E(2) between 6 March and 6 August 1989 at three test sites: Norman, Oklahoma; Tinker Air Force Base (AFB), Oklahoma; and Oklahoma City, Oklahoma. The purpose of IOT&E (2) was fourfold: to evaluate the operational effectiveness and suitability of the preproduction NEXRAD for DOC, DOD, and DOT to support a full-production decision; to review deficiencies and enhancements documented by the test team during IOT&E(1A) and IOT&E(1B); to identify deficiencies and enhancements not previously documented; and to identify items to be addressed during follow-on operational test and evaluation (FOT&E).

1.1 AUTHORIZING DIRECTIVES. Memorandum of Agreement for Next Generation Weather Radar Initial Operational Test and Evaluation Phase II (NEXRAD IOT&E(2)), November 1988; Next Generation Weather Radar Test and Evaluation Master Plan, March 1985; Air Force Program Management Directive 1058(12)/PE 63707F/64707/35111F, March 1988; and Next Generation Weather Radar (NEXRAD) Initial Operational Test and Evaluation Phase II (IOT&E(2)) Plan (U), November 1988.

1.2 BACKGROUND OF OT&E. In October 1983, the NEXRAD Program Council (NPC) requested that the Air Force Operational Test and Evaluation Center (AFOTEC) conduct the NEXRAD IOT&E. The NPC members and the AFOTEC Commander signed a memorandum of agreement (MOA) in April 1984 outlining the specific responsibilities of AFOTEC as the lead IOT&E agency and the associated IOT&E responsibilities of DOC, DOD, and DOT. The NEXRAD IOT&E approach was approved by the AFOTEC Commander on 21 August 1984 and by the NPC on 14 September 1984. The NEXRAD test and evaluation master plan (TEMP) was coordinated and approved by all participating agencies in March 1985. The TEMP details the responsibilities of the participants and the general IOT&E scenario. The NPC members and the AFOTEC Commander signed a second MOA on 2 November 1988 which focused on IOT&E(2), updated all agencies' specific responsibilities, and superseded the April 1984 NEXRAD MOA.

a. Between 11 August and 31 October 1986, two independent test elements with members from DOC, DOD, and DOT, under the overall management of AFOTEC, conducted IOT&E(1A) of the two competing contractors' (Raytheon and Unisys, formerly Sperry) NEXRAD units. Each independent test element identified a number of deficiencies and enhancements during test. As a result of these IOT&E(1A) findings and other pertinent information, the NPC directed both contractors to continue development and prepare for additional testing--IOT&E(1B).

b. Two independent test elements, again under the overall management of AFOTEC, conducted IOT&E(1B) of the two competing contractors' NEXRAD units from 13 April to 22 May 1987. This test provided information to the NPC as an aid in selecting a single contractor for the limited production phase and identified a number of deficiencies that required correction before the start of IOT&E(2). Unisys was selected as the limited-production contractor, and preparations for IOT&E(2) began.

1.3 DESCRIPTION OF SYSTEM TESTED. During IOT&E(2), a single validation phase preproduction NEXRAD system, consisting of one Radar Data Acquisition (RDA) unit, one Radar Product Generation (RPG) unit, and four Principal User Processing (PUP) units, was tested. The RDA unit included a Doppler radar and the software to perform system signal processing, clutter suppression, control, error detection, and calibration. The RPG unit included the hardware and software for real-time generation, storage, and distribution of radar products for operational use and for overall NEXRAD system control, status monitoring, error detection, and data archiving. The PUP included the hardware and software for the request, display, storage, and annotation of products. It also included the hardware and software for the control of the PUP, status monitoring, and data archiving. The operational, full-production NEXRAD system is expected to provide the same capabilities, but with revised software, a higher data bit rate capability between the RPG and RPG Operational Position, a production model transmitter, the hydrology functionality, and revised algorithms. DOC, DOD, and DOT have the option to acquire approximately 175 radar systems and 356 PUPs. Approximately 160 of these systems are planned to be configured into a national weather radar network, which would provide radar coverage for the 48 contiguous states. Each NEXRAD system, with the associated communications, data processing hardware and software, display, and data entry equipment, was designed to acquire, process, and distribute radar information on the location, structure, intensity, and movement of weather phenomena. The agencies developed the operational concept of a Unit Radar Committee (URC) to coordinate the radar operational configuration to best support all associated users. The test team implemented this concept for IOT&E(2).

1.4 TEST FORCE, LOCATION, DATES. A 160-member, integrated tridepartmental test team, comprised of DOC, DOD, and DOT personnel under the overall management of AFOTEC, conducted an IOT&E(2) on the Unisys preproduction NEXRAD system. Agency operations, maintenance, and training specialists also contributed their expertise in test activities. IOT&E(2) was divided into two parts (A and B). Part A, combining development test and evaluation (DT&E), OT&E, and contractor activities, began on 6 March 1989 and continued through 7 May 1989. Part B (dedicated OT&E) began on 8 May 1989 and continued through 6 August 1989. The test was conducted by test team operators in the Oklahoma City (OKC) Weather Service Forecast Office (WSFO) in Norman, Oklahoma (DOC personnel); the Base Weather Station (BWS) at Tinker Air Force Base (TAFB), Oklahoma (DOD personnel); and the Federal Aviation Administration (FAA) Academy in Oklahoma City, Oklahoma (DOT personnel). Maintenance and software personnel conducted test activities from integrated, tridepartmental work centers located in Norman, Oklahoma, with trips, as necessary, to the other test sites.

1.5 CLASSIFICATION STATEMENT. There is no classified information associated with the NEXRAD program.

SECTION II - OT&E DESCRIPTION

2.0 CRITICAL OPERATIONAL ISSUES/OBJECTIVES.

2.0.1 <u>Critical Operational Issues (COIs)</u>. Five COIs were defined in the TEMP and IOT&E(2) test plan and are shown below. These issues were reviewed and approved by all participating agencies and by the NPC.

a. Performance. Does NEXRAD provide adequate information in a format that will allow DOC, DOD, and DOT personnel to generate accurate and timely warnings of hazardous weather events?

b. Availability. Is NEXRAD sufficiently reliable, maintainable, and logistically supportable to achieve the required operational availability?

c. Responsiveness. Does the NEXRAD system effectively react to multiple users' needs? Is the system capable of processing many different types of requests from many different users? Is the system capable of processing high-priority requests?

d. Growth Capability. Are both hardware and software capable of accommodating system expansion and update in the future?

e. Interoperability. Can NEXRAD operate in conjunction with existing and planned weather information systems/networks?

2.0.2 <u>Objectives</u>. The test was based on eight effectiveness, seven suitability, and three combined effectiveness and suitability objectives derived from the five COIs. Table II-1, paragraph 2.0.3, is a matrix of the COIs and objectives. Definitions of the terms evaluate, assess, met requirements, and did not meet requirements are contained in the glossary in appendix E. For evaluate-level objectives, the test team compared test data against user-stated criteria; for assess-level objectives, the test team collected and reported information on high-interest areas without criteria.

a. Objective E-1. Evaluate NEXRAD as an effective aid in preparing accurate and timely weather warnings.

b. Objective E-2. Evaluate NEXRAD's impact on operator workload.

c. Objective E-3. Assess whether current position qualifications for agency personnel are adequate to effectively use NEXRAD.

d. Objective E-4. Evaluate NEXRAD capability to provide required operational support to multiple users.

e. Objective E-5. Evaluate NEXRAD as an effective aid in preparing accurate and timely weather advisories.

f. Objective E-6. Evaluate NEXRAD as an effective aid in providing routine weather services.

g. Objective E-7. Assess NEXRAD as an effective aid to meeting agency mission requirements when changing to, operating on, and recovering from backup power.

h. Objective E-8. Assess NEXRAD electromagnetic compatibility (EMC).

i. Objective ES-9. Assess the adequacy of the planned NEXRAD training to provide the skills required to effectively use and maintain NEXRAD.

j. Objective ES-10. Assess impacts of any safety hazards associated with NEXRAD.

k. Objective ES-11. Assess factors impacting the interoperability of NEXRAD with existing and planned systems.

l. Objective S-12. Assess NEXRAD reliability.

m. Objective S-13. Evaluate NEXRAD maintainability.

n. Objective S-14. Evaluate NEXRAD availability.

o. Objective S-15. Assess the adequacy of logistics support.

p. Objective S-16. Evaluate NEXRAD software maintainability.

q. Objective S-17. Assess the adequacy of planned and existing NEXRAD software support resources (SSR).

r. Objective S-18. Assess NEXRAD software usability.

2.0.3 COIs. Table II-1 contains a matrix of the COIs and objectives.

Table II-1

Critical Operational Issues/Test Objectives Matrix

		COIs				
	Test Objectives	1	2	3	4	5
E-1	Weather Warnings	X				X
E-2	Operator Workload	X				X
E-3	Position Qualifications	X				
E-4	Support to Multiple Users			X		
E-5	Weather Advisories	X				X
E-6	Routine Weather Services	X				X
E-7	Backup Power Operations	X	X			
E-8	Electromagnetic Compatibility	X				X
ES-9	Training	X	X			
ES-10	Safety	X	X	X	X	
ES-11	Interoperability					X
S-12	Reliability	X	X			
S-13	Hardware Maintainability	X	X			
S-14	Availability	X	X	X		
S-15	Logistics Support		X			
S-16	Software Maintainability	X	X		X	
S-17	Software Support Resources	X	X	X	X	X
S-18	Software Usability	X	X	X		

COI 1 = Performance
COI 2 = Availability
COI 3 = Responsiveness
COI 4 = Growth Capability
COI 5 = Interoperability

2.1 SCOPE AND METHOD OF ACCOMPLISHMENT.

2.1.1 Scope. The duration of IOT&E(2) was 5 months and was divided into two parts (A and B). Part A was a combined DT&E and OT&E period which began on 6 March 1989 and continued through 7 May 1989. During Part A, the use of the NEXRAD was shared among DT&E, OT&E, and contractor activities. Part B began on 8 May 1989 and continued to the end of test on 6 August 1989. During the first 10 weeks of Part B, the NEXRAD system was dedicated to operational testing 24 hours per day, 7 days per week. This 10-week period was the data collection period for the reliability, maintainability, and availability (RM&A) data calculations. During the last 2 weeks of Part B, the test team focused on service report activities and verification of PTM maintenance procedures and technical data.

a. Operations. The test team operated NEXRAD in accordance with current operational concepts and procedures to support actual operational missions of the DOC and DOD and a simulated mission environment of DOT. For DOC and DOD, the NEXRAD system was used as an aid in conducting their normal meteorological operations of providing weather warnings, weather advisories, and routine weather services support to a wide range of customers. The DOC's weather support area encompassed 51 counties in Oklahoma, while the DOD's responsibility was primarily limited to an area within 5 nautical miles (nm) of Tinker AFB. For the DOT, the NEXRAD was used as an aid in conducting simulated Center Weather Service Unit (CWSU) operations over a geographical area which encompassed most of Oklahoma. Test team specialists used a separate PUP located in the NEXRAD Operational Support Facility (OSF). To evaluate NEXRAD's capability to support multiple users, the test team used the three operational PUPs, the OSF PUP, and a unit loader to simulate an operationally representative processing load of a 19-user NEXRAD site.

b. Maintenance. The test team performed organizational-level maintenance on the system for the entire 5 months of the test. The primary maintenance activities were troubleshooting system malfunctions to the line-replaceable unit (LRU) or hardware components and performing remove and replace actions or hardware/software resets as required. When the test team required assistance to complete the organizational-level maintenance, the contractor was requested to provide field maintenance services in accordance with the Contractor Support Services Plan (CSSP). In addition, the contractor provided depot-level maintenance support. Preventive maintenance inspections (PMIs) were conducted and evaluated by the test team.

c. Software. The test team conducted a wide range of software activities. Selected software documentation and source listings were reviewed to evaluate the maintainability of the NEXRAD software. The adequacy of planned and existing NEXRAD software support resources was also assessed. System documentation and implementation standards were reviewed for adequacy to support interoperability with existing and planned systems (such as Automation of Field Operations and Services System, Automated Weather Distribution System, and Advanced Weather Interactive Processing System). The usability of the operator and maintainer NEXRAD software interfaces was also assessed.

2.1.2 Questionnaires.

2.1.2.1 Operations. Nine measures of effectiveness (MOEs) required operator evaluation. To evaluate these MOEs, the test team developed and used several questionnaires.

a. Operator Questionnaire. The test team used a 147-question Operator Questionnaire to record the opinion of operators on the effectiveness of NEXRAD during ICT&E(2) Part B. The Operator Questionnaire contained a single general question for each primary MOE. In addition, the questionnaire contained supplemental questions that allowed each operator to amplify conclusions or to point out specific areas of concern. This questionnaire used a 6-point response scale (see table II-2) for objectives E-1, E-4, E-5, and E-6 and a 5-point scale (see table II-3) for objective E-2. Operators were required to provide comments for the objectives that the test team addressed at the assess level (i.e., objectives E-3, E-7, E-8, and ES-9).

Table II-2

Operational Effectiveness Response Scale

Response	Description
6	Completely Effective
5	Highly Effective
*4	Mildly Effective • Meets operator's minimum operational needs
3	Mildly Ineffective
2	Highly Ineffective
1	Completely Ineffective

*Criterion

Table II-3

Operational Workload Response Scale

Response	Description
5	Significant decrease in workload • May require less manning to meet existing agency requirements
4	Slight decrease in workload when using NEXRAD to meet existing agency requirements
3	No change in workload when using NEXRAD to meet existing agency requirements
*2	Slight increase in workload when using NEXRAD to meet existing agency requirements
1	Significant increase in workload • May require additional manning to meet existing agency requirements

*Criterion

b. Weather Warning Questionnaire. To evaluate and document the performance of NEXRAD for specific weather warning events, the test team had operators complete Weather Warning Questionnaires. The test team reviewed these Weather Warning Questionnaires for comments and reported specific aspects of NEXRAD warning support performance.

c. School of Aerospace Medicine (SAM) Form 202, Crew Status Survey. To evaluate workload impacts during a specific shift, operators indicated on this survey their peak and average workload, subjective fatigue at the beginning and end of a shift, type of weather that occurred during the shift, and the amount of unscheduled activities.

d. Operator Demographics Questionnaire. This questionnaire provided the test team with each operator's current job, qualification (e.g., meteorologist, weather officer, weather forecaster, and weather observer), education level, and years of experience.

e. Responsiveness Questionnaire. Operators completed the Responsiveness Questionnaire to document the demonstrated responsiveness of NEXRAD during a specific operator shift and unit loader scenario.

f. Operations Training Questionnaire. The test team operators completed the Operations Training Questionnaire to document strengths and weaknesses of the six-phase, IOT&E(2), NEXRAD operations training course.

2.1.2.2 Maintenance:

a. Maintenance Incident Questionnaire. The test team used the Maintenance Incident Questionnaire to provide qualitative information to support the operational suitability evaluation.

b. Maintenance Training Questionnaire. Maintenance technicians completed the Maintenance Training Questionnaire to document strengths and weaknesses of provided NEXRAD maintenance training.

c. Training/Skill Level Assessment Questionnaire. Maintenance technicians completed the Training/Skill Level Assessment Questionnaire to provide qualitative information on overall training and skill level requirements.

2.1.2.3 Software. The test team used six questionnaires in the evaluation and assessment of the software-related objectives. The questionnaires used a 6-point response scale (see table II-4).

a. Software Documentation Questionnaire. The test team software evaluators used the standardized Software Documentation Questionnaire from AFOTEC Pamphlet (AFOTECP) 800-2, volume III, Software Maintainability Evaluation Guide, to evaluate the NEXRAD software documentation.

b. Module Source Listing Questionnaire. The test team software personnel used the standardized Module Source Listing Questionnaire from AFOTECP 800-2, volume III to evaluate the software source listing maintainability.

c. Software Life Cycle Process Questionnaire. The test team used a modified Software Life Cycle Processor Questionnaire based on the questionnaire from AFOTECP 800-2, volume II, Life Cycle Management Process Evaluation Guide, to assess the adequacy of planned and existing software support resources. The questionnaire was modified by deleting questions with a focus on early contractor actions.

Table II-4

Software Questionnaire Response Scale

Response	Description
6	COMPLETELY AGREE: There must be absolutely no doubt when using this response that the characteristic being evaluated is totally satisfactory with respect to the characteristic addressed.
5	STRONGLY AGREE: This response indicates that the characteristic being evaluated is very good and is very helpful for software supportability.
4	GENERALLY AGREE: This response indicates that the characteristic being evaluated is satisfactory, but may require improvements to make it helpful for software supportability.
3	GENERALLY DISAGREE: This response indicates that the characteristic being evaluated is unsatisfactory, and some improvements are required to make it helpful for software supportability.
2	STRONGLY DISAGREE: This response indicates that the characteristic being evaluated is unsatisfactory, and major improvements are required before it would be helpful for software supportability.
1	COMPLETELY DISAGREE: There must be absolutely no doubt when using this response that the characteristic being evaluated is totally unsatisfactory with respect to the characteristic addressed.

Averages of 3.5 and above indicate generally favorable characteristics.

d. Software Support Resources (SSR) Evaluation Questionnaire. The test team used the standardized SSR Evaluation Questionnaire from AFOTECP 800-2, volume V, Software Support Resources Questionnaire, to assess the adequacy of planned and existing software support resources.

e. Software Usability Questionnaire (SUQ). The test team used the standardized SUQ from AFOTECP 800-2, volume IV, Software Usability Evaluation Guide, to assess the usability of the system software interfaces.

f. Software Training Questionnaire. The test team used a Software Training Questionnaire to assess the provided 7-week software training course and the planned software training.

2.1.3 Questionnaire Administration and Application.

2.1.3.1 Operations. The operational effectiveness objectives relied on the opinion of the NEXRAD operators obtained through questionnaires.

a. Operator Questionnaire. The Operator Questionnaire was the primary evaluation tool used by the test team to evaluate NEXRAD against the effectiveness objectives. Additional data were collected and statistics calculated for supporting MOEs. These additional data are not discussed in this report except in those cases where the results conflicted with the median responses determined from the Operator Questionnaire. When administering the Operator Questionnaire, the test team used a structured interview process to focus the operator's responses on the test objectives and to encourage discussion after each question had been rated. Written comments on each question were strongly encouraged to provide additional insight into the operator's evaluation. During the Operator Questionnaire administration at the end of Part B, operators were instructed to answer each question twice. They were instructed to base their first response on their experience when the system was operating regardless of system outages. For their second response, the evaluators were instructed to consider overall system performance including the impact of system outages during IOT&E(2) Part B. For clarity and to separate effectiveness and suitability issues, the questionnaire responses based on when the system was operating were used as the sole measure in evaluating NEXRAD against users' requirements. Therefore, the results and conclusions for the effectiveness objectives reflect the operators' opinions of NEXRAD's effectiveness only when the system was operating. The operators' responses which addressed overall system performance (including impacts of availability) will be discussed in paragraph 3.19.

b. Weather Warning Questionnaire. Following any operations shift during which severe or potentially severe weather occurred in or near their area of warning responsibility, operators completed a Weather Warning Questionnaire for the event. These Weather Warning Questionnaire responses for specific events were used to supplement the primary weather warning MOE data obtained through the Operator Questionnaire.

c. SAM Form 202, Crew Status Survey. The SAM Form 202 was administered to each operator at the end of each shift during Part B. Data from incomplete forms or when the radar was down for maintenance were excluded from analysis. An analysis of these data was used to supplement the primary workload MOE data obtained through the Operator Questionnaire.

d. Operator Demographics Questionnaire. Before testing began, the test team collected operator qualification information by administering the Operator Demographics Questionnaire to each operator.

e. Responsiveness Questionnaire. Operators completed this questionnaire at the end of each shift during Part B.

f. Operations Training Questionnaire. Operators completed the training questionnaire at the end of phase 2 of the IOT&E(2) NEXRAD operations training course, at the end of phase 4, at the end of phase 6 (DOD only), and prior to the end of the test (DOD only). Agency training specialists reviewed completed questionnaires to support the assessment of the adequacy of planned agency NEXRAD operations training.

2.1.3.2 Maintenance:

a. Maintenance Incident Questionnaire. The maintenance technicians completed a Maintenance Incident Questionnaire after each maintenance action. Responses from the questionnaire were examined to aid in the assessment of safety, diagnostics, training, support equipment, spares, and any other area affecting maintainability.

b. Maintenance Training Questionnaire. The maintenance technicians completed the Maintenance Training Questionnaire after each block of instruction during the 7-week course. The test team used the questionnaire results in the qualitative assessment of maintenance training.

c. Training/Skill Level Assessment Questionnaire. The maintenance technicians completed the Training/Skill Level Assessment Questionnaire at the end of training and again prior to the end of their participation in IOT&E(2). Responses were used as part of the overall assessment of the training and skill level requirement.

2.1.3.3 Software. The evaluation and assessment of the software-related objectives relied on the expert opinion of the test team evaluators obtained through questionnaire responses and written comments. IOT&E(2) results were based on the average evaluator responses on the questionnaires.

a. Software Documentation Questionnaire. The documentation of four computer program configuration items (CPCIs) was evaluated by 10 software evaluators using the Software Documentation Questionnaire. The average of the questionnaire responses and the written comments were used to form the basis of the software documentation evaluation.

b. Module Source Listing Questionnaire. One hundred seventy-nine randomly selected modules were evaluated by two teams of five software evaluators each, using the Module Source Listing Questionnaire. The average of the questionnaire responses and the written comments were used to form the basis of the software source listing evaluation.

c. Software Life Cycle Process Questionnaire. Using the information available at the time of the test, 10 software evaluators completed the Software Life Cycle Process Questionnaire. Discussion was encouraged to ensure and focus understanding of each question. The questionnaire responses were used to identify trends that were then reinforced by the written comments to form the basis of the software life cycle process assessment.

d. Software Support Resources Evaluation Questionnaire. Using the information available at the time of the test, 10 software evaluators completed the Software Support Resources Evaluation Questionnaire. Discussion was encouraged to ensure and focus understanding of each question. The questionnaire responses were used to identify trends that were then amplified by the written comments to form the basis of the software support resources assessment.

e. Software Usability Questionnaire. The SUQ was administered to the operators and maintainers using a structured interview process to focus the responses on the question objective. Discussion was encouraged. The questionnaire responses and the written comments were used to form the basis of the software usability assessment.

f. Software Training Questionnaire. The Software Training Questionnaire was administered after each block of instruction during the 7-week software training course. The questionnaire responses were used to identify trends that were then amplified by the written comments to form the basis of the software training assessment.

2.1.4 Supporting Data Document (SDD). The SDD is a separate document that provides an index to the summary statistics (e.g., operator questionnaire response histograms) and raw data collected, compiled, analyzed, and written for all primary and supporting MOEs. It was prepared by the test team and is maintained by HQ AFOTEC/RS. Requests for these basic data should be directed to that office.

2.2 PLANNING CONSIDERATIONS AND LIMITING FACTORS.

2.2.1 Planning Considerations. Planning considerations which affected the scope or conduct of IOT&E(2) are listed below:

a. Acquisition Baseline. A formal acquisition baseline and corresponding documentation were not required contractor-deliverable items for IOT&E(2). The test team conducted IOT&E(2) with a baseline determined by the minimum test start criteria and the status of the system at test start.

b. Simulated NEXRAD Network. The test team used only four PUPs and a single radar unit. Network demands were simulated through dial-up communications lines and a unit loader.

c. Use of Existing Weather Radar. There was a legal requirement to use commissioned radars to meet information dissemination requirements. Therefore, DOC and DOD continued to refer to existing weather radars to provide weather services. The IOT&E(2) of the NEXRAD unit was an added requirement to existing duties with no reduction in the requirement to use the existing radars.

d. Limited Maintenance On-The-Job Training (OJT). The agencies' training concept for maintenance specified that trained, experienced personnel would provide OJT to all maintenance technicians following contractor-provided training. Since this was a new system, a body of trained, experienced government personnel was not available to fulfill this function.

2.2.2 Limiting Factors. Limitations to the test team's ability to conduct a completely realistic IOT&E(2) are listed below. Despite these limitations, the test emphasized operational realism throughout IOT&E(2) to the maximum extent possible. Each limitation should be addressed in the FOT&E outlined in the NEXRAD TEMP (March 1985).

a. Validation Phase Preproduction System. The system tested did not include certain capabilities (e.g., hydrology functionality, higher data rate capability between the RPG and RPG Operational Position, revised production phase algorithms, and production model transmitter) to be implemented in the limited or full-scale production phases. Therefore, full system capability could not be determined.

b. Limited Integrated Logistics Support. The provisioning process for spares and support equipment was not completed before the end of the test. The test team used a limited contractor-proposed, Joint System Program Office (JSPO)-approved spares and support equipment package and a PTM. Therefore, the system's future operational mean downtime and the adequacy of the spares and support equipment concepts could not be determined.

c. Limited DOT Operational Work Environment. Most of the support equipment that is normally part of an Air Route Traffic Control Center, CWSU, and Flow Control Unit was not available at the simulated CWSU facility at the FAA Academy. In addition, most real-time mission responsibilities could not be simulated. Therefore, the effectiveness of NEXRAD as an aid to an operational CWSU could not be determined.

d. Software Support Resources. Government software support resources were not in place. Software support plans and procedures, scheduled to be published after IOT&E(2), were not available. Therefore, the government procedures for software support could not be fully evaluated.

2.3 CONTRACTOR INVOLVEMENT:

a. Unisys (the primary contractor) and two of their subcontractors (Westinghouse and Concurrent Computer Corporation) provided field maintenance services (on an "as required" basis to complete organizational-level maintenance) and depot-level maintenance support in accordance with the approved CSSP. This was in accordance with the maintenance concept. Unisys also provided operations, maintenance, and software training for IOT&E personnel. Concurrent Computer Corporation and Westinghouse provided additional maintenance training to test team technicians.

b. Maintenance actions performed by contractors were observed over-the shoulder by test team maintenance technicians and were documented on maintenance data collection (MDC) forms. This ensured that contractor involvement was within the framework of the maintenance concept. All data collection and processing were done by the test team to ensure data and analysis integrity. All identified system deficiencies have been reported through the service report (SR) process in accordance with Technical Order (TO) 00-35D-54, USAF Materiel Deficiency Reporting and Investigating System.

SECTION III - OPERATIONAL EFFECTIVENESS AND SUITABILITY

3.0 SUMMARY. NEXRAD was an effective aid in providing weather warning (objective E-1), weather advisory (objective E-5), and routine weather services (objective E-6) support. Although there was only a slight increase in operator workload when operators used the PUP only, there was a significant increase in operator workload when operators used the PUP and Unit Control Position (UCP) together (objective E-2). Operators, specialists, and supervisors stated that existing agency position qualifications were adequate for using NEXRAD (objective E-3). The system was responsive in providing required products when operating under a representative maximum user load (objective E-4). NEXRAD often failed to recover automatically from backup power transitions (objective E-7). The test team noted one apparent EMC problem--a wavy presentation on the RDA application terminal throughout IOT&E(2) (objective E-8). Numerous deficiencies were identified in planned agency operations, maintenance, and software training (objective ES-9). The test team identified and documented 56 safety deficiencies, 9 of which had the potential to cause death, severe injury, or major system damage (objective ES-10). Deficiencies in the interface documentation made it difficult and time-consuming for test team members to find and organize interoperability information (objective ES-11). The system mean time between maintenance (MTBM) (total corrective) was 25.3 hours; four reliability problems were identified with the preproduction transmitter RPG, graphics processor, and optical disk drive units (objective S-12). Demonstrated NEXRAD maintainability, fault isolation (objective S-13), and availability (objective S-14) did not meet the users' requirements. Numerous deficiencies were identified with support equipment, sparing, and the PTM (objective S-15). The evaluated software documentation and source code listings for four CPCIs met the users' requirements (objective S-16); however, serious deficiencies were identified with the overall documentation. There is a risk that the existing and planned software support resources may not be adequate for the government to assume software support responsibility (objective S-17). The test team assessed the usability of six NEXRAD software interfaces and identified several deficiencies (objective S-18).

3.1 OBJECTIVE E-1. Evaluate NEXRAD as an effective aid in preparing accurate and timely weather warnings.

3.1.1 Method. To evaluate this objective, DOC and DOD operators used NEXRAD information to assist in preparing operational weather warnings during IOT&E(2). The test team used the Weather Warning Questionnaire and the Operator Questionnaire to document individual warning events and general NEXRAD performance, respectively, during IOT&E(2) Part B. In addition, the test team collected weather warning verification statistics and specialists reports to support the operators' evaluation.

3.1.1.1 Weather Warning Procedures. NEXRAD was operated and evaluated using existing agency procedures and requirements. DOC meteorologists issued warnings for 51 counties within Oklahoma as prescribed in Weather Service Operations Manual (WSOM) chapter C-47 and station duty manuals. DOD forecasters issued warnings within a 5 nm radius of Tinker AFB in accordance with OC-ALC-TAFB Regulation 105-1, Weather Support, and current standard operating procedures (SOPs). DOT meteorologists do not issue weather warnings as part of their existing agency support.

3.1.1.2 Operator Questionnaire. The test team used the Operator Questionnaire to record the opinions of operators on NEXRAD as an effective aid for weather warnings. The Operator Questionnaire was administered at the end of Part B. The rating for this objective was based on the operators' median response to the question "What was the overall effectiveness of NEXRAD as an aid for you in preparing accurate and timely weather warnings?" (question number 1, appendix F). The test team compared this median response to the criterion. The criterion was a median response of 4 or greater on a 6-point scale (ranging from 1 = completely ineffective to 6 = completely effective). A score of 4 or greater would indicate that NEXRAD was an effective aid in preparing weather warnings.

3.1.1.3 Weather Warning Questionnaire. To evaluate and document the performance of NEXRAD for specific weather warning events, the test team had operators complete Weather Warning Questionnaires. Following any operations shift during which severe or potentially severe weather occurred in or near their area of warning responsibility, operators completed a Weather Warning Questionnaire for that event. The test team reviewed these Weather Warning Questionnaires for comments and reported specific aspects of NEXRAD warning support performance. These Weather Warning Questionnaire responses for specific events were used to supplement the primary MOE data obtained through the Operator Questionnaire.

3.1.1.4 Weather Warning Verification. The test team made use of existing agency verification networks and specialists to verify the success or failure of weather warnings. The test team used DOC's verification network that consisted of over 2,500 trained severe weather spotters. Doppler radar specialists from the National Severe Storms Laboratory (NSSL) used the PUP located in the OSF to compare NEXRAD product performance with observed weather. To gain additional weather warning verification data, one to three storm intercept teams were often sent out. In addition, following significant weather events when the severity of the storms were uncertain, the test team sent out storm damage survey teams to collect verification data.

3.1.1.5 Weather Warning Statistics. Based on the weather warning verification data, the test team calculated weather warning statistics to support the operator's evaluation. These weather warning statistics were probability of detection (POD); false alarm rate (FAR); critical success index; and capability, warning, and event lead times. The glossary in appendix E provides a definition of these statistics.

3.1.2 Results and Conclusions. NEXRAD met the users' requirements for weather warning support. The Operator Questionnaire median response for the 22 DOC and DOD operators was 4 (mildly effective, meets operator's minimum operational needs). During IOT&E(2), the 11 DOC operators used NEXRAD as an aid to issue 681 weather warnings within their 51-county warning area in Oklahoma. The 11 DOD operators used NEXRAD as an aid to issue 44 weather warnings for the area within 5 nm of Tinker AFB. Severe weather was reported within at least one of these two warning areas on 55 of the 154 test days.

3.1.2.1 Operators stated that NEXRAD met their minimum operational requirements as an aid in preparing accurate and timely weather warnings. This effectiveness was achieved primarily because of the high resolution and accuracy of the NEXRAD reflectivity-based products. The high resolution allowed operators to determine the internal storm structure and better understand the atmospheric conditions. The reflectivity-based products aided the operators in preparing severe thunderstorm warnings throughout their area of warning responsibility. The capability to magnify and time-lapse storms in high-color resolution, the use of background maps, and the use of the reflectivity-based Vertically Integrated Liquid Water (VIL) product were particularly effective. With NEXRAD, DOC operators were able to accurately specify the counties or parts of counties included in a warning area and the time duration for the warning event.

3.1.2.2 However, the test team identified deficiencies that impacted the operational effectiveness of NEXRAD for weather warning support. During widespread convective activity, velocity-based products were often severely degraded by large areas of range-folded and incorrectly dealiased data (see Glossary, appendix E). DOC operators stated that these severely degraded velocity-based products were highly ineffective as an aid in analyzing storms for their tornadic potential. In many cases, winds associated with gust fronts approaching Oklahoma City and Tinker AFB were masked by range-folded data from second trip echoes. DOD plans specified that DOD radars will be sited 10 to 35 miles from a DOD installation in the direction of the prevailing storm track such that the storms normally cross over the installation before reaching the radar. Therefore, unless corrected, range-folded data will likely mask most winds associated with gust fronts approaching DOD installations. Additionally, the incorrectly dealiased velocity fields and the current state of the mesocyclone detection and hail algorithms resulted in numerous false severe weather indications. For example, Doppler radar specialists from NSSL estimated the false alarm rate associated with the mesocyclone detection algorithm was greater than 50 percent. Further, the DOC operators could not locate severe storms with respect to Oklahoma cities and towns with the contractor-provided background maps. To overcome this deficiency, DOC operators developed a city background map of sufficient detail to prepare accurate weather warnings.

3.1.3 Recommendations. For JSPO:

a. Eliminate the impact of range-folded data on the velocity-based products. (SR 219)

b. Provide an effective velocity dealiasing algorithm. (SRs 500, 062B, 441, 507)

c. Provide reliable hail and mesocyclone algorithm outputs. (SRs 208, 380, 228A)

d. Provide complete background maps with adequate detail. (SRs 050, 349, 238A, 281, 122, 433)

3.2 OBJECTIVE E-2. Evaluate NEXRAD's impact on operator workload.

3.2.1 Method. To evaluate this objective, NEXRAD was operated by BWS, WSFO, and CWSU meteorologists, forecasters, and observers using existing agency procedures and requirements. The test team used the Operator Questionnaire to evaluate general workload impacts during IOT&E(2) Part B. The test team used the SAM Form 202, Crew Status Survey, to document individual workload impacts during specific operator shifts. In addition, site supervisors and agency specialists commented on their observations of workload impacts during IOT&E(2).

3.2.1.1 Operational Procedures. To evaluate NEXRAD's impacts on operator workload, test team operators used NEXRAD as an aid to prepare weather warnings, weather advisories, and routine weather services using existing agency requirements and procedures. Specific operational procedures are provided in paragraph 3.1.1.1 for warnings, paragraph 3.5.1.1 for advisories, and paragraph 3.6.1.1 for routine services. Since this objective addressed NEXRAD's impact on operator workload to meet only existing agency requirements, workload associated with the new radar-coded message (RCM) requirement is addressed separately in objective E-6 (routine services).

3.2.1.2 Workload Impacts. Operators addressed the workload impact of two NEXRAD activities: obtaining and interpreting meteorological products at the PUP and controlling NEXRAD equipment using the UCP. The test team evaluated the impacts of both of these activities. Each test site had a PUP. However, in order to allow both the DOC and DOD operators to use the UCP during IOT&E(2), the test team positioned the UCP at Tinker AFB for the first 6 weeks of Part B and at the OKC WSFO for the remainder of the test. During the first 6 weeks of Part B, the DOC and DOT operators evaluated the workload impact of the PUP only, while the DOD evaluated both the PUP and UCP together. For the remainder of IOT&E(2), the DOC operators evaluated the workload impact of the PUP and UCP together, while the DOD and DOT evaluated the PUP only. Current agency plans do not require DOT operators to use a UCP.

3.2.1.3 Operator Questionnaire. To evaluate the two primary MOEs, the test team administered the Operator Questionnaire to all test team operators in a structured interview process (see paragraphs 2.1.1.1 and 2.1.2.1). Using a 5-point scale, operators evaluated workload impacts as the result of using the NEXRAD PUP only. Using the same 5-point scale, operators then evaluated workload impacts of using both the NEXRAD PUP and UCP together. The ratings for this objective were based on the operators' median response to these two questions: (a) "What was the impact on workload when you used the NEXRAD PUP to perform existing agency requirements?" (b) "What was the impact on workload when you used the NEXRAD PUP and UCP to perform existing agency requirements?" (question numbers 2 and 3, appendix F). The test team compared the median response with the users' criterion. The criterion for each MOE was a median response of 2 or greater on the 5-point scale. A score of 2 or greater would indicate that there was no significant increase in workload when using NEXRAD in performing agency requirements.

3.2.1.4 School of Aerospace Medicine Form 202. The SAM Form 202, Crew Status Survey, was administered to each operator at the end of each shift during Part B. On this form, the operators indicated their peak and average workload, subjective fatigue at the beginning and end of a shift, type of weather that occurred during the shift, and the amount of unscheduled activities. Data from incomplete forms or when the radar was down for maintenance were excluded from analysis. An analysis of these data was used to supplement the primary MOE data obtained through the Operator Questionnaire.

3.2.1.5 Site Supervisors. Site supervisors at the OKC WSFO and the Tinker AFB BWS (meteorologist in charge (MIC), deputy MIC, detachment commander, and chief of weather station operations) provided the test team with end-of-test reports during the last 2 weeks of Part B. Part of each report addressed the workload impacts of NEXRAD on forecast office/base weather station operations.

3.2.1.6 Agency Specialists. Specialists from the agency and regional headquarters observed NEXRAD operations at the operational test sites. At the end of the 5 to 10 day review, these specialists provided trip reports addressing the impact of NEXRAD on operator workload. The test team used these reports to supplement the operators' evaluation.

3.2.2 <u>Results and Conclusions</u>. NEXRAD met the users' requirement for operator workload when the NEXRAD PUP alone was used to perform existing agency weather support activities. The Operator Questionnaire median response for 29 operators from the three agencies was 2 (slight increase in workload). The operator workload when the UCP and PUP were used together did not meet the users' requirement. The Operator Questionnaire median response for 26 DOC and DOD operators was 1 (significant increase in workload).

3.2.2.1 PUP Only Workload Impacts. DOC and DOD operators found that using the NEXRAD PUP alone to meet existing agency requirements resulted in a slight increase in operator workload while DOT operators found it would produce a significant increase in their workload.

a. DOC and DOD operators stated that to adequately examine the NEXRAD-provided information, additional radar interpretation time was required. However, these operators also stated that the slight increase in workload was accompanied with an increased understanding of the current state of weather conditions. In addition, DOC and DOD operators experienced a slight increase in workload as a result of the initial unfamiliarity with many NEXRAD functions. DOC and DOD operators found that, as with their existing weather radars, using NEXRAD in potentially severe weather situations required a dedicated operator.

b. DOT operators stated that manually acquiring and examining products from multiple NEXRADs would produce a significant increase in their workload. The Operator Questionnaire median response for three DOT operators was 1. The time required to dial individual RPGs and perform one-time requests would likely degrade the effectiveness of CWSU meteorologists' ability to meet their mission requirements if the planned Real-time Weather Processor is unable to automate this function.

3.2.2.2 PUP and UCP Workload Impacts. Operators stated that using the UCP and the PUP together produced a significant increase in operator workload. Operators noted that this was primarily the result of required system responsibilities to support the multiple-user radar configuration. These responsibilities included system status monitoring, maintenance problem identification, maintainer notification, environmental wind updating, pulse repetition frequency changes, associated users coordination, and volume coverage pattern selection. The UCP duties were sometimes delayed or not performed because of other mission requirements. This often resulted in the NEXRAD system operating in a mode that was not optimal for the existing weather conditions. Because of limitations associated with the free text message (FTM) functionality, operators at the UCP site were frequently interrupted from mission duties to respond to telephone calls from the other two associated PUP sites or to initiate calls to them. Operators also stated that the inconsistent UCP and PUP menus and problems with UCP keystroke entry further hindered the accomplishment of UCP duties. Results from the SAM Form 202 analysis and site supervisor reports also indicated that there was an increase in operator workload when the UCP was at the operator's test site.

3.2.3 Recommendations. For JSPO:

a. Correct deficiencies with the UCP user interface. (SRs 530, 168A, 009A, 167, 402, 173, 082B, 337, 164, 069, 177, 175, 174)

b. Correct deficiencies associated with the FTM functionality. (SRs 027B, 178, 446, 447, 445)

c. Correct deficiencies associated with the dialup interface. (SRs 395, 394, 515)

3.3 OBJECTIVE E-3. Assess whether current position qualifications for agency personnel are adequate to effectively use NEXRAD.

3.3.1 Method. To assess position qualification requirements, the test team collected operator demographics information and comments from operators, site supervisors, and agency specialists.

3.3.1.1 Operator Demographics Questionnaire. Before testing began, the test team collected operator qualification information by administering the Operator Demographics Questionnaire. This questionnaire asked for the operator's current job, qualification (e.g., meteorologist, weather officer, weather forecaster, or weather observer), education level, and years of experience. Thirty-one operators (eleven DOC and five DOT meteorologists, two DOD weather officers, nine DOD weather forecasters, and four DOD weather observers) completed this questionnaire. The education level of the 31 respondents ranged from high school through masters degree. The number of years of weather-related experience ranged from less than 1 year to over 30 years. The range of education levels and number of years of weather-related experience were representative of each agency's personnel.

3.3.1.2 Operator Questionnaire. The operators answered the Operator Questionnaire (see paragraphs 2.1.1.1 and 2.1.2.1) which addressed, in addition to the other objectives, whether current qualifications were adequate for effective NEXRAD use. All operators assessed qualification requirements for effective use of the PUP. In addition, DOC and DOD operators assessed qualification requirements for the effective use of the UCP.

3.3.1.3 Site Supervisor and Agency Specialists. Site supervisors at the OKC WSFO and the Tinker AFB BWS and agency specialists provided the test team with position qualification assessment reports.

3.3.2 Results and Conclusions.

3.3.2.1 There was a consensus among operators, supervisors, and specialists of all three agencies that current agency position qualifications were adequate for NEXRAD. However, they stated that without proper training, personnel having these qualifications will not be able to use NEXRAD PUPs and UCPs effectively for the duties of their assigned positions (e.g., meteorologist, weather officer, weather forecaster, or weather observer). (The adequacy of NEXRAD operator training plans are addressed in objective ES-9.)

3.3.2.2 In addition, site supervisors and agency specialists provided additional position qualification assessment comments. DOD supervisors stated that weather observers could be trained to perform, without direct supervision, observer-related PUP functions and to enter UCP commands under a forecaster's guidance. DOC supervisors and specialists stated that although current DOC plans do not include training for meteorological technicians on the use of NEXRAD, personnel in these positions could, with proper training, assist meteorologists in performing NEXRAD duties.

3.3.3 Recommendation. For JSPO and users: Ensure effective and appropriate NEXRAD operations training is provided to agency personnel (also see objective ES-9, Training).

3.4 OBJECTIVE E-4. Evaluate NEXRAD capability to provide required operational support to multiple users.

3.4.1 Method. To evaluate this objective, the test team used a combination of existing operational procedures and proposed new procedures for the NEXRAD era. In addition to three operational PUPs and the OSF PUP, the test team used a unit loader to simulate an operationally representative processing load. Finally, the test team analyzed questionnaires, operator comments, product response times, and product availability logs.

3.4.1.1 Operational Procedures. The test team operated NEXRAD in accordance with current agency operations manuals and procedures (i.e., WSOM, SOPs, etc.). For NEXRAD-unique requirements, the test team used the draft Federal Meteorological Handbook No. 11 (FMH-11) and agency-prepared test operating procedures (TOPs). These documents reflected planned agency taskings for required forecast products and services. As described in FMH-11, designated agency representatives from the three agency test sites periodically met as the URC to coordinate the operation of NEXRAD.

3.4.1.2 Unit Loader Simulation. In conjunction with the RPG processing load generated by the three associated PUPs at the operational sites and the OSF PUP, a unit loader was used to generate an additional processing load which was representative of a multiple-user (19 user) NEXRAD site. The unit loader simulated requests for products considered typical of four associated PUPs, eight nonassociated PUPs, two other users, and one RPG principal user external system (PUES) port. The unit loader recorded product request information such as time of request, time of receipt, and product availability for simulated users, along with such load factors as number of users (both real and simulated), product request scenarios, and active scan strategy. The unit loader did not record responsiveness statistics for the three operational PUPs and the OSF PUP. The test team ran the unit loader using product-request scenarios which were coordinated and approved by representatives from DOC, DOD, and DOT. Four different scenarios were developed prior to IOT&E(2) and used throughout the test; three specified representative product requests for convective and stratiform activity and a fourth specified a clear-air scenario. All scenarios were developed using a strong emphasis on requests for derived products while minimizing the requests for base products.

3.4.1.3 Operator Questionnaire. The test team used the Operator Questionnaire to record opinions on NEXRAD's responsiveness during IOT&E(2) part B. The Operator Questionnaire was administered at the end of Part B. The rating for this objective was based on the operators' median response to the question "What was the overall effectiveness of NEXRAD in providing requested products in a timely manner when you operated the unit in various weather scenarios at the representative maximum load?" (question number 4, appendix F). The test team compared this median questionnaire response with the criterion. The criterion was a median rating of 4 or greater on a 6-point scale (see table II-2) (ranging from 1 = completely ineffective to 6 = completely effective). A score of 4 or greater would indicate that the NEXRAD system provided requested products in a timely manner when operating at a representative maximum load.

3.4.1.4 Responsiveness Questionnaire. To document the responsiveness of NEXRAD during a specific operator shift and unit loader scenario, test team operators completed the Responsiveness Questionnaire. At the end of each shift, operators used this form to document specific demonstrated responsiveness characteristics of NEXRAD. Later, the test team deputy for data management and analysis annotated on the Responsiveness Questionnaire which unit loader scenario, if any, was active during the shift. The operators used their own completed and annotated Responsiveness Questionnaires as memory joggers when answering the multiple-user MOE questions on the Operator Questionnaire.

3.4.1.5 Site Supervisors and Agency Specialists. Site supervisors, meteorological specialists, and communications specialists from the using agencies provided reports on NEXRAD responsiveness issues. The test team used the comments provided in these reports to supplement and expand on specific aspects of NEXRAD multiple-user support.

3.4.2 <u>Results and Conclusions</u>. NEXRAD's capability to provide required operational support to multiple users met the users' requirement. The Operator Questionnaire median response for 31 operators was 4 (mildly effective, meets operator's minimum operational needs). However, special cases were identified and are described below where NEXRAD did not meet specific portions of this overall objective.

3.4.2.1 For associated users, operators from the three test sites stated that, in general, NEXRAD provided routine product set (RPS) products in a timely manner including times when the unit was operated in a mode simulating a 19-user configuration. Data from the unit loader appeared to support this evaluation. Overall RPS product availability for the simulated users was 99.6 percent for all weather scenarios run during Part B as shown in table III-1. The unit loader recorded only one event of narrowband loadshedding for the simulated associated user PUPs.

Table III-1

Unit Loader RPS Statistics

Operating Mode	Products Received	Products CPU Loadshed	Products Memory Loadshed	Products Missing	Percent Unavailable
Precipitation	32230	40	13	10	0.2%
Clear Air	4507	57	10	19	1.9%
Total	36737	97	23	29	0.4%

Note: Unit Loader statistics are for simulated PUPs only.

CPU Loadshed: Products not received as the result of Central Processing Unit (CPU) loadshedding.
Memory Loadshed: Products not received as the result of memory allocation not available.
Missing: Products not received; not attributed to CPU or Memory Loadshedding. This included the one narrowband loadshedding event.

3.4.2.2 In contrast to the operator evaluation and unit loader statistics, test team specialists observed that narrowband loadshedding at the three operational PUP sites prevented the receipt of many RPS products during periods of widespread precipitation. This discrepancy was possibly due to differences in the number and type of RPS products on the simulated users' RPS lists versus the actual PUPs' lists. The simulated PUPs' RPS lists, which remained constant throughout the test and were based on the coordinated agency concepts (see paragraph 3.4.1.2), contained mostly derived products and relatively few base products. However, during IOT&E(2), operators were allowed to modify their RPS lists at their sites. As the limitations with some of the derived products became apparent, operators placed more base products and relatively few derived products on their RPS lists. The base products had longer transmission times than derived products which increased the likelihood of narrowband loadshedding for the actual PUPs versus the simulated PUPs. Table III-2 shows product transmission times for derived and base products for one widespread precipitation event.

3.4.2.3 Operators stated that while some one-time requested products were received in a timely manner, the responsiveness of many one-time requested products did not meet their needs. Unit loader statistics supported this statement. These statistics indicated that one-time product response times varied considerably depending on the amount of data that were sent over the narrowband lines and whether or not the product was already generated at the RPG. Most base products were received within 1 minute from request. Most derived products were received within 30 seconds. However, those products that would normally be requested via the one-time request feature (e.g., cross-section products and Weak-Echo Region (WER) products) had a mean response time on the order of 2.5 to 3 minutes during convective activity. Because of their reliance on cross-section and

WER products during the test and dialup feature limitations, the DOT operators stated that the responsiveness of the NEXRAD system did not meet their operational requirements.

Table III-2

Approximate Product Transmission Times for a Widespread Precipitation Event (0000 GMT-0200 GMT, 23 Jun 89)

Base Products	Time (seconds)	Derived Products	Time (seconds)
Reflectivity (1 km)	23	Severe Weather Probability	less than 1
Reflectivity (2 km)	19		
Velocity (1 km)	16	Hail	7
Spectrum Width (1 km)	23	Mesocyclone	1
Velocity (1/4 km)	17	Storm Structure	4
Spectrum Width (1/4 km)	32	Layered Composite Turbulence	2

3.4.2.4 For nonassociated users, operators and specialists identified several deficiencies. First, dialup procedures for acquiring products from multiple RPGs were cumbersome and time-consuming. This deficiency will particularly impact agency centers requiring routine access to multiple RPGs. Second, the RPG telephone number directory could only contain a maximum of 12 digits for each RPG, making long-distance dialing through most facility switchboards impossible. Third, background maps from nonassociated RPGs were automatically deleted from the PUP data base after only 6 hours. In addition, the functionality to store and retrieve maps using optical disk media was inoperable. Therefore, operators had to repeatedly request maps over dialup lines. Fourth, unit loader simulations indicated product receipt times for nonassociated PUPs were generally 50 percent greater than those for associated PUPs. These slower product receipt times were likely the result of the simulated nonassociated PUPs operating at a lower narrowband transmission rate. In the limited production phase design, the transmission rates for nonassociated PUPs are planned to be upgraded to the associated PUPs' transmission rate.

3.4.2.5 Site supervisors and specialists found that the multiple site coordination procedures used during IOT&E(2) were effective, but additional issues need to be addressed. Site supervisors found the URC was an effective forum for the principal user agencies to coordinate the use of NEXRAD. Test team specialists noted that URC-developed agreements need to be quickly incorporated into each station's operating procedures. Further, the specialists identified the need for strong agency support and guidance regarding multiple-user support functions and how NEXRAD-related responsibilities relate to current duty priorities. The need for this guidance was particularly demonstrated when the UCP operator's area of interest was not threatened by significant weather while severe weather was entering the warning area of a different associated user.

3.4.3 Recommendations.

3.4.3.1 For JSPO:

a. Provide an effective capability to acquire products from multiple RPGs. (SRs 395, 393, 394, 515)

b. Provide the capability to retain nonassociated background maps in a separate PUP storage area. (SR 410)

c. Provide the capability to store and retrieve nonassociated RPG background maps. (SR 338, 326)

d. Investigate the adequacy of NEXRAD to support receipt of products during periods of widespread precipitation. (SR 502)

e. Ensure cross-section and WER products are received in a timely manner.

3.4.3.2 For users:

a. Develop procedures for responsive implementation of URC-coordinated changes at individual associated site locations.

b. Provide guidance regarding multiple-user support functions and how NEXRAD-related responsibilities relate to current duty priorities.

3.5 OBJECTIVE E-5. Evaluate NEXRAD as an effective aid in preparing accurate and timely weather advisories.

3.5.1 Method. To evaluate this objective, operators used NEXRAD information to assist in preparing operational weather advisories during IOT&E(2). The test team used the Operator Questionnaire to evaluate general NEXRAD advisory performance during IOT&E(2) Part B. In addition, the test team collected weather advisory verification statistics and specialists' comments to support the operators' evaluation.

3.5.1.1 Weather Advisory Procedures. NEXRAD was operated and evaluated using existing agency weather advisory procedures as well as existing and test-specific weather advisory support requirements. DOC, DOD, and DOT operators used NEXRAD information to assist them in preparing advisories for existing criteria. In addition to the existing DOD advisory criteria at Tinker AFB that do not require a lead time, five DOD specialists prepared test specific forecast advisories for Tinker AFB that required a positive leadtime during selected shifts in Part A.

3.5.1.2 Advisory Verification and Statistics. Using the same methodology identified in paragraphs 3.1.1.4 and 3.1.1.5, the test team collected verification information and calculated advisory statistics to assess the accuracy and timeliness of weather advisories. Operators made maximum use of existing agency verification networks. In addition, DOT operators requested pilot reports from nearby air traffic control center and tower facilities. For the DOD forecast advisories, the test team collected and analyzed the verification statistics of POD, FAR, and leadtime (see Glossary in appendix E for definitions).

3.5.1.3 Operator Questionnaire. The test team used the Operator Questionnaire to collect the opinion of operators on NEXRAD as an aid for weather advisories. The Operator Questionnaire was administered at the end of Part B. The rating for this objective was based on the operators' median response to the question "What was the overall effectiveness of NEXRAD as an aid for you in preparing weather advisories?" (question number 5, appendix F). The test team compared this median response with the criterion. The criterion was a median rating of 4 or greater on a 6-point scale (ranging from 1 = completely ineffective to 6 = effective). A score of 4 or greater would indicate that NEXRAD was an effective aid in preparing weather advisories.

3.5.1.4 Specialists. Doppler radar specialists from NSSL and the principal user agencies provided reports addressing the effectiveness of NEXRAD as an aid in preparing advisories. The NSSL report focused on NEXRAD algorithm performance while agency specialists focused on general advisory support issues.

3.5.2 Results and Conclusions. NEXRAD met the users' requirement for weather advisories. The Operator Questionnaire median response for the 27 forecasters and meteorologists from the three agencies was 4 (mildly effective, meets operator's minimum operational needs).

3.5.2.1 Operators stated that NEXRAD met their minimum operational requirements as an aid in preparing accurate and timely weather advisories. Operators reported that the resolution of the reflectivity products allowed them to accurately identify the location of significant weather with respect to specific advisory and aircraft route locations. The sensitivity of the reflectivity products allowed operators to identify many features such as gust fronts, thunderstorm outflow boundaries, and fine lines. Identification of these features, combined with the use of Velocity Azimuth Display (VAD) wind profiles and base velocity products to identify inversions and low-level jet streams, enabled operators to provide timely terminal wind advisories and low-level wind shear advisories. In addition, during Part A, DOD specialists achieved a POD of 100 percent and a FAR of 17 percent for the seven prepared forecast advisories.

3.5.2.2 However, the test team identified deficiencies that impacted the operational effectiveness of NEXRAD for weather advisory support. Operators did not find useful information in the layered-turbulence products. This limitation prevented DOT from using this product in preparing aircraft advisories for turbulence, a key element of required CWSU weather support. Therefore, DOT operators used reflectivity-based products to infer potential turbulent regions associated with convective activity and velocity-based products to infer potential turbulent regions in clear air conditions. Previously identified deficiencies with velocity dealiasing and range-folded velocity data often prevented operators from determining the strength of winds associated with convective-related features identified in the reflectivity data (e.g., gust fronts). When convective activity was within 10 nm of the RDA, the delivered scan strategies did not provide the operators with an adequate vertical distribution of the storm's reflectivity. This difficulty was due to the delivered scan strategy only sampling below 20 degrees in elevation. Therefore, operators could not see the upper levels of the storm. As a result, DOD operators had difficulties in canceling observed-thunderstorm advisories for Tinker AFB when convective activity was within 10 nm of the RDA. The test team noted two limitations associated with the use of the automated alert feature that reduced this feature's effectiveness. First, the current state of the storm-series algorithms appeared to produce frequent false indications of significant weather (e.g hail and mesocyclonic shear). NSSL specialists estimated that greater than 50 percent of the mesocyclone alerts were false. Second, specialists observed that because of inadequate applications training, operators did not always know how to apply alert thresholds and alert areas to match existing meteorological conditions.

3.5.3 Recommendations.

3.5.3.1 For JSPO:

a. Provide effective layered turbulence products. (SRs 160, 421)

b. Eliminate the impact of range-folded data on the velocity-based products. (SR 219)

c. Provide an effective velocity dealiasing algorithm. (SRs 500, 062B, 411)

d. Provide effective hail and mesocyclone algorithms. (SRs 380, 228A)

3.5.3.2 For JSPO and users: Provide adequate training on the appropriate application of the automated alert feature for each users' weather support requirements. (SRs 015, 247, 455)

3.6 OBJECTIVE E-6. Evaluate NEXRAD as an effective aid in providing routine weather services.

3.6.1 Method. To evaluate this objective, operators used NEXRAD information to assist in providing routine weather services during IOT&E(2). The test team used the Operator Questionnaire to evaluate general NEXRAD routine weather support performance during IOT&E(2) Part B. In addition to these current weather services, DOC operators edited RCMs during selected shifts.

3.6.1.1 Operating Procedures. Test team operators provided routine meteorological services as outlined in the respective agencies' current operating procedures. These routine services included terminal forecasts (DOD), surface weather and radar observations (DOD), weather briefings (DOC, DOD, DOT), nowcasts (DOT, DOC), and routine weather forecasts and statements (DOC).

3.6.1.2 Operator Questionnaire. The test team used the Operator Questionnaires to evaluate NEXRAD as an aid in providing routine weather support. The Operator Questionnaire was administered at the end of Part B. The ratings for this objective were based on the operators' median responses to the following questions: (a) "What was the overall effectiveness of NEXRAD as an aid for you in preparing short-range forecasts?" (b) "What was the overall effectiveness of NEXRAD as an aid for you in taking surface weather observations?" (c) "What was the overall effectiveness of NEXRAD as an aid for you in preparing and presenting weather briefings?" (d) "What was the effectiveness of NEXRAD as an aid for you in briefing traffic management on weather problems that could impact local traffic flow or local air traffic control capabilities?" (questions numbered 6 through 9 in appendix F). The test team compared these four median responses with the corresponding criteria. The criterion for each of the four aspects of routine services was a median rating of 4 or greater on a 6-point scale (ranging from 1 = completely ineffective to 6 = completely effective). A score of 4 or greater would indicate that NEXRAD was an effective aid in providing that aspect of routine support.

3.6.1.3 Radar Coded Message (RCM). The test team assessed the impact of the new DOC requirement of editing and transmitting an RCM each hour. During selected shifts in IOT&E(2) Part B, DOC operators edited the RCM using guidance in the draft FMH-11, Part E. Under various weather situations, the test team collected RCM editing times and the percentage of RCMs edited before dissemination.

3.6.2 Results and Conclusions. NEXRAD met the users' minimum requirement as an effective aid in short-range forecasts, surface observations, briefings, and aircraft traffic management. The median response from the 31 operators for forecasts, surface observations, and flow control was a 4 (mildly effective, meets operator's minimum needs). The median response for 26 meteorologists and forecasters for weather briefings was a 4.5 (between mildly and highly effective).

3.6.2.1 NEXRAD was an effective aid in the preparation of short range (0 to 6 hour) forecasts. The high resolution and sensitivity of NEXRAD aided in the identification of fronts, wind shift lines, precipitation areas, and dry lines. Clear-air mode operation was particularly effective in identifying small-scale features. VAD and base velocity products, when not contaminated by large areas of range-folded and incorrectly dealiased data, aided in the preparation of surface forecasts and in diagnosing vertical wind field changes.

3.6.2.2 DOD observers stated that NEXRAD was an effective aid in preparing surface weather observations. Observers used the Echo Tops product, Storm Tracking Information product, and time-lapse feature to determine storm identification, location, and movement for inclusion in surface observation remarks. Based on current requirements, DOD forecasters and observers stated they were able to prepare a reflectivity-only radar observation more accurately and typically in less than half the time with NEXRAD than is presently required for the FPS-77 weather radar.

3.6.2.3 Operators stated that NEXRAD was an effective aid in preparing and presenting weather briefings. DOD forecasters stated that the ability to time-lapse color radar information and to remote that information to the briefing counter was particularly valuable. DOC operators were able to prepare civil defense briefings using NEXRAD primarily because of the detailed reflectivity data placement on the county and operator-generated city background maps. DOT and DOD operators noted the usefulness of the reflectivity and VAD products aided in displaying the meteorological conditions for planned briefings. However, the DOT operators stated that on-demand briefing effectiveness was degraded because one-time and dialup product requests were not responsive (see objective E-4).

3.6.2.4 The automatic scan mode deselection feature often forced an operationally undesirable switch to the precipitation mode because of anomalous propagation (AP). The design of the deselection feature prevented the operator from reselecting the clear-air mode for at least 1 hour after changeover. At these times, the increased detection capability of the clear-air mode was not available to support routine operations.

3.6.2.5 All DOC operators stated that the new requirement of editing the RCM produced a significant increase in their workload. Operators spent significant time verifying and removing residual clutter, AP, and false indications of mesocyclones and hail. The automated remarks in Part C of the RCM did not provide useful information and required extensive editing. Operators stated that because of other mission requirements, 42 RCMs were sent out without being edited, 19 of which were during severe weather (see table III-3).

3.6.3 <u>Recommendations</u>.

3.6.3.1 For JSPO:

a. Eliminate the impact of range-folded data on the velocity-based products. (SR 219)

b. Provide an effective velocity dealiasing algorithm. (SRs 500, 082B, 441)

c. Reduce the impact of the RCM on operator workload. (SRs 484, 258A, 307, 358, 411, 333, 427, 336, 385)

d. Ensure one-time products are received in a timely manner for on-demand briefings. (SR 166A)

e. Provide an effective capability to acquire products from multiple RPGs. (SRs 395, 393, 394, 515)

Table III-3

RCM Editing Distributions

	Number of RCMs	Percentage of RCMs (%)
Total RCMs Required	**176**	**100**
Sent Out Edited		
Appropriate	100	57
Inappropriate	3	2
Total	103	59
Sent Out Unedited		
Reason:		
Other mission requirements Severe Weather	19	11
Other mission requirements Nonsevere Weather	23	13
Total	42	24
Not Sent Out		
Reason:		
Radar Down	31	17
Total	31	17

3.6.3.2 For JSPO and users: Provide the UCP operator the capability to override the automatic scan mode deselect feature and 1-hour timeout when operationally required. Ensure the FMH-11 allows the UCP operator to use this capability. (SR 250A)

3.7 OBJECTIVE E-7. Assess NEXRAD as an effective aid to meeting agency mission requirements when changing to, operating on, and recovering from backup power.

3.7.1 Method. The test team assessed the performance of NEXRAD when operating on and transitioning to and from backup power. The test team used the Operator Questionnaire results and the maintenance logs to assess this objective.

3.7.1.1 Operational Procedures. Operators used NEXRAD as an aid in conducting required weather support services. Current agency weather support plans, used by the test team, required weather services to continue following the loss of commercial power. In addition to the unplanned loss of commercial power, operators often switched to backup power in anticipation of commercial power fluctuations during severe weather.

3.7.1.2 Operator Questionnaire. The test team used the Operator Questionnaire to record the opinion of the operators on NEXRAD's effectiveness during power transitions and while operating on backup power. The Operator Questionnaire was administered to 31 test team operators at the end of Part B. The Operator Questionnaire requested comments addressing the quality, continuity, and availability of NEXRAD products while operating on backup power and following transitions to and from backup power. The operators also provided comments addressing any significant NEXRAD-related workload impacts caused by backup power transition recovery actions.

3.7.1.3 Maintenance Data Review. Maintenance technicians noted reliability and maintainability problems caused by power transitions or the use of backup power. They documented equipment deficiencies as service reports. Outage times were collected on the MDC forms.

3.7.2 Results and Conclusions. NEXRAD was not an effective aid in meeting agency mission requirements when changing to and recovering from backup power.

3.7.2.1 During IOT&E(2) Part B, the system failed 17 times (RDA 4 times, RPG 12 times, and PUP 1 time) because of power transitions--whether unscheduled or operator-initiated. In these cases, a maintenance action and a manual restart were required. Outage times resulting from power transfers ranged from 11 minutes to 8 hours 54 minutes. These failures resulted in an increase in workload, an increase in maintenance interventions, and the loss of critical radar data. Operators stated that the loss of critical radar data during significant weather situations resulted in a significant decrease in the effectiveness of NEXRAD as an aid in providing weather warning and advisory support. Conversely, operators observed that the three operational PUPs recovered automatically after power transitions except for one event at Tinker AFB.

3.7.2.2 Operators did not observe any change in system performance or operator workload when NEXRAD was operating on backup power.

3.7.3 Recommendation. For JSPO: Ensure the RDA and RPG effectively and automatically return to an operational state following power transitions. (SRs 317, 087B)

3.8 OBJECTIVE E-8. Assess NEXRAD electromagnetic compatibility (EMC).

3.8.1 Method. The test team maintenance technicians and operators noted, by exception, apparent EMC problems that produced performance anomalies in NEXRAD or in nearby electronic systems. They assessed, where possible, anomalies that may have been attributable to EMC problems.

3.8.2 Results and Conclusions. The test team maintenance technicians noted one apparent EMC problem--a wavy presentation on the RDA applications terminal throughout IOT&E(2). Although the technicians replaced the monitor, the wavy presentation continued. Operators did not observe any EMC incidents associated with the operation of NEXRAD equipment, nor was there any observable effect on any nearby equipment.

3.8.3 Recommendation. For JSPO: Investigate and resolve the cause of the RDA applications terminal having a wavy presentation. (SRs 051A, 131)

3.9 OBJECTIVE ES-9. Assess the adequacy of the planned NEXRAD training to provide the skills required to effectively use and maintain NEXRAD.

3.9.1 Method. Operations, maintenance, and software personnel received training for IOT&E(2).

3.9.1.1 Operations Training. Operations training was a government-designed, six-phase training course specially developed for IOT&E(2). Five of the six phases of training were government provided. The fourth phase of operations training was a 2-week contractor-provided course which was not representative of the government planned 4-week operator course.

3.9.1.2 Maintenance Training. The maintenance training course for IOT&E(2) was initially designed to be the same as the planned 6-week maintenance course. However, based on the results of the first half of the course, the JSPO instructed the contractor to restructure the course and to add another week. At the conclusion of the 7 weeks of training, the JSPO discovered that crucial sections of the course had not been provided. The test team technicians received an additional 3-day training course in the middle of IOT&E(2) Part A to correct this deficiency.

3.9.1.3 Software Training. Software training was a 7-week, contractor-provided course that was intended to be an equivalent subset of the planned 14-week software course. In the IOT&E(2) course, only four CPCIs were addressed in detail rather than the 18 CPCIs to be presented in the 14-week course.

3.9.1.4 Data Analysis. Based on test team training specialists' review of the contractor's training plans, course outlines, and training aids together with knowledge gained through classroom and hands-on training and the results of questionnaires, the test team assessed the adequacy of planned NEXRAD operations, maintenance, and software training. In addition, operations training specialists reviewed the comments provided by the 31 operators from all three agencies to assess planned operations training.

3.9.2 <u>Results and Conclusions</u>.

3.9.2.1 Operations. Ten agency training specialists identified numerous deficiencies associated with the planned NEXRAD operations courses.

a. Test team training specialists stated that the planned Cadre and Interim Operations Courses were deficient. The Cadre course lacked sufficient detail and would not adequately prepare agency instructors to teach NEXRAD operations. In addition, they stated the Interim Operations Course would not support the training of students to the agency-required skill level. Considering meteorological content, both courses had inadequate depth both in product interpretation and in the application of products to different weather scenarios. Further, the courses' structural deficiencies included inadequate student and instructor guides. The order of presentation of the topics for these courses was difficult to follow and not logical.

b. DOC training specialists stated that DOC/DOT-planned computer-based training (CBT) was an area of high risk. Training specialists identified four significant deficiencies associated with the planned CBT. First, the CBT design did not include functionality critical to NEXRAD operations (e.g., RPS list management, one-time product requests, and effective time lapse). Second, CBT workstations will not provide the necessary hands-on experience required for confident decision making. Third, modifications to the CBT course, necessary to reflect the expected changes in NEXRAD functionality, will likely be time-consuming and expensive. The time to modify CBT software and firmware, test, and reinstall may impact training schedules. Fourth, current plans did not address required on-site training.

c. A comprehensive DOD NEXRAD operations training plan had not been prepared. DOD training specialists stated that general concepts and unofficial course outlines were available, but the level of detail contained in these documents was inadequate to ensure that the training will prepare operators to meet mission requirements. The outlined DOD concept for NEXRAD installation training, which included precursor, mobile training team, and on-the-job training (OJT), lacked sufficient detail to indicate the contribution of each training phase towards certification. For instance, skill levels and prerequisite training for each phase were not part of an integrated plan. Several other deficiencies were also noted, including the absence of training on UCP operations, extended adaptation data modification, and system console operation. Formal course requirements had not been finalized; consequently, manpower requirements to support training had not been adequately defined.

d. The PUP training mode and NEXRAD archive functionality demonstrated a potential to support hands-on operations training. However, test team-identified deficiencies with these features limited their usefulness during IOT&E(2). For example, the archive functionality was unreliable and the training mode did not permit the operator to specify scenario start times.

3.9.2.2 Maintenance. Without significant changes, the planned NEXRAD maintenance training will not provide the necessary training for an agency technician to acquire the needed skills to effectively maintain a NEXRAD system in accordance with the maintenance concept.

a. The test team identified several deficiencies with planned maintenance training. First, the course objectives were not sufficiently specific to determine the adequacy of the course length. Second, the course contained insufficient instruction in several areas, including the basic theory of computer architecture, digital electronics, modems, fiber optics, communication theory (narrowband and wideband), the use and configuration of complex test equipment, and software functions and interfaces. Third, the precursor training, an integral part of the overall training, was not addressed in the contractor's plan. The government was developing a precursor package, but this planning was not complete. Fourth, specialists expressed concern that the training course development, as well as hands-on training, might suffer because of system time-sharing at the OSF between operations, maintenance, and software training; software development; DT&E; field support; and downtime for failures.

b. The test team documented several deficiencies associated with the 7-week IOT&E(2) maintenance course. The PTM, which was used as the primary course reference, was ineffective as a training tool (see objective S-15). Training was presented without sufficient detail and did not interrelate the functionality of components. The flow of instruction did not follow an organized, logical plan. The instructors did not demonstrate an in-depth knowledge of the NEXRAD system. The allotted hands-on time did not achieve the training objectives. As a result, maintenance technicians stated that on 83 out of 159 maintenance actions documented on maintenance incident questionnaires during IOT&E(2), required training was either inadequate (41 actions) or not provided (42 actions). These training deficiencies directly contributed to the excessive troubleshooting and repair times experienced during IOT&E(2) (see objective S-13).

c. The 8 hours of computer maintenance training taught by Concurrent Computer Corporation personnel during the 3-day additional training course more closely achieved the training goals because these lessons were logically structured and well-presented. However, the technicians stated that too much information was presented in too short a period.

d. Unless these training problems are resolved before the start of cadre training, the goals of the NEXRAD maintenance concept will not be achieved and operational availability will probably be adversely affected.

3.9.2.3 Software. The planned NEXRAD software training will probably not provide the skills necessary to effectively maintain the NEXRAD software.

a. The proposed 14-week course was planned to be presented only once during the lifetime of NEXRAD. A review of this planned course showed that the same deficiencies identified in the 7-week IOT&E(2) course (discussed below) will likely be repeated. particularly in the areas of course structure, level of detail, and laboratory instruction techniques. In addition, no follow-on, OJT, or additional formal training was planned. No provisions had been made to train personnel hired after the course was presented.

b. The software evaluators identified several deficiencies with the 7-week IOT&E(2) software maintenance course. First, the structure of the course did not follow an organized, logical plan. Class members were required to learn information on their own to complete laboratory exercises, only to receive the corresponding formal instruction later. Information about CPCIs was intermixed with other CPCIs and taught over several days, making it difficult for class members to discern the separate functionality of each CPCI. Second, the focus and level of detail presented were not adequate to maintain the NEXRAD software. The course provided an adequate knowledge of the organization and operation of NEXRAD software but not the detailed skills and procedures needed for software maintenance. Some objectives which required detailed discussions, such as software debug tools, were presented in a few hours. Other objectives which required less detail, such as the NEXRAD overview, took almost 4 days. Also, time was inefficiently spent going over each possible response in each menu during class and in the laboratory. The visual aids and the three volumes of student training material used in the course contained insufficient useful information. Third, there was insufficient hands-on laboratory experience with the NEXRAD software maintenance procedures. Laboratory time consisted of "follow-me" exercises rather than the complete software problem resolution process. The laboratories were not long enough for troubleshooting software problems. Insufficient time was allocated to complete a build of a CPCI. The use of support tools to modify, build, and test the software was not adequately addressed.

c. The course instructors provided by the contractor were, however, highly qualified. They were knowledgeable on the subject material and covered the material in the course outline. System perspectives were well-presented and gave a good understanding of the NEXRAD system components.

d. Unless the deficiencies identified above are corrected, software maintainers will likely require an extensive on-the-job trial-and-error process to acquire the skills needed to maintain the NEXRAD software.

3.9.3 Recommendations.

3.9.3.1 For JSPO:

a. Operations:

(1) Ensure adequacy of Personnel Requirements, Training, and Training Equipment Plan (CDRL 218) in meeting agency operations training requirements.

(2) Correct deficiencies associated with the PUP training mode. (SRs 059, 162, 460, 579, 505)

(3) Correct deficiencies associated with NEXRAD archive functionality to help support operator training. (SRs 120, 325, 351, 194, 338)

b. Maintenance: Ensure the technical manuals are sufficiently upgraded and adequate course material is developed to meet both the theory and hands-on training requirements of the cadre training course and the first increment of field maintainers. (SRs 014, 265A, 129, 440, 138A, 227, 328, 384, 138, 286, 420, 544, 251)

c. Software:

(1) Ensure the contractor's 14-week software maintenance course is restructured to follow a logical, organized plan.

(2) Ensure the focus and level of detail of the contractor's 14-week software maintenance course provide the students instruction in the proper use of software tools necessary to maintain the NEXRAD software.

(3) Ensure the contractor's 14-week software maintenance course provides adequate hands-on laboratory time.

3.9.3.2 For JSPO and Users - Maintenance:

a. Ensure the contractor's maintenance instructors are sufficiently knowledgeable of NEXRAD to teach both theory and hands-on maintenance for all functional areas. Until Unisys demonstrates the ability to provide an adequate training course, make maximum use of subcontractor equipment training experts (e.g., Concurrent Computer Corporation training instructors).

b. Ensure detailed lesson plans are developed well in advance of cadre training. Inspect these plans to determine adequacy of course content and length.

c. Ensure the course contains an introduction to all areas of instruction that have not been previously taught to current 5-level technicians (e.g., fiber optics, computer architecture, etc.).

3.9.3.3 For DOC and DOT - Operations:

a. Evaluate the potential of supplementing CBT instruction at the training site with hands-on use of PUPs and an RPG using Archive II playback capability.

b. Prepare training materials to address on-site, follow-on NEXRAD training.

3.9.3.4 For DOD - Operations:

a. Ensure a comprehensive, coordinated training plan is developed.

b. Ensure manpower requirements to meet training needs are adequately defined and personnel are available in time to prepare for cadre training.

3.9.3.5 For the OSF:

a. Ensure adequate OJT materials and a follow-on software maintenance course are developed for training OSF software personnel.

b. Ensure adequate system time is provided for operations, maintenance, and software course development and for hands-on instruction during laboratory sessions.

3.10 OBJECTIVE ES-10. Assess impacts of any safety hazards associated with NEXRAD.

3.10.1 Method. The intent of this objective was to identify and, where possible, eliminate all safety hazards. Prior to the start of IOT&E(2), a safety specialist from Headquarters AFOTEC conducted an on-site safety inspection of the NEXRAD unit and the test facility. Throughout the test, all test team personnel were tasked with assessing and documenting potential hazards noted with equipment, operations, and maintenance actions. System safety was addressed in conjunction with all objectives to identify potential problem areas which may require future engineering, design changes, or procedural modifications. Areas were identified that may cause injury to personnel and/or damage to equipment and reduce the effectiveness and/or suitability of the NEXRAD system.

3.10.1.1 Test team personnel examined the contractor's facility plans, drawings, PTM, and the AFOTEC pre-IOT&E(2) safety inspection report. All identified safety hazards were documented as SRs.

3.10.2 Results and Conclusions. The test team identified and documented 56 safety deficiencies during IOT&E(2). Nine of the deficiencies were hazards that had the potential to cause death, severe injury, or major system damage (Category I). The immediate hazards associated with these nine deficiencies were temporarily resolved for the test. However, permanent solutions must be incorporated into the production systems. Of the remaining 47 safety deficiencies (Category II), 16 had the potential to cause minor injury to personnel, 22 had the potential to cause either minor injury to personnel or minor damage to equipment, while the other 9 had the potential to cause minor equipment damage only.

3.10.2.1 The areas with the largest number of safety deficiencies identified during IOT&E(2) were in the RDA shelter (16 SRs), the radome/tower (15 SRs), and the generator shelter (6 SRs). Additionally, the inadequate warnings and equipment power-down/power-up procedures in the PTM produced potentially significant hazards to personnel and equipment.

3.10.2.2 Of the 33 safety-related deficiencies identified during IOT&E(1A) and IOT&E(1B), the test team revalidated 7. Four of these deficiencies were in the redesigned radome/tower area.

3.10.2.3 The greatest potential for personnel injury existed within the radome area. Two serious safety deficiencies with the radome maintenance hatch were identified during IOT&E(1A), and the same deficiencies, along with hazards associated with the radome davit, were noted during IOT&E(2). The temporary solution to these problems was that organizational-level maintenance personnel would not be required to use the hatch or davit; however, a long-term solution is needed. Additionally, four potentially serious safety hazards associated with access to the top of the antenna pedestal and the radome obstruction lights were identified during IOT&E(2). First, no means was provided to safely transport equipment/tools to and from the top of the pedestal (hand-carrying items up a temporary ladder was prohibited by Military Standard 1472C). Second, procedures did not require the use of a safety belt while standing on the temporary ladder and working. Third, the transition between the temporary ladder and the fixed ladder on the back of the antenna was dangerous. Fourth, after ascending the fixed ladder to the top of the antenna, maintenance technicians could not safely access the obstruction lights. Unless the proper safety equipment is installed and safe procedures are documented for working on, or near, the top of the pedestal for the production systems, a high potential for serious injury exists.

3.10.3 Recommendations. For JSPO:

a. Ensure the contractor corrects all identified Category I safety deficiencies. (SRs 168, 012, 010, 264A, 262A, 190, 189, 011, 009, 076, 049, 061A)

b. Ensure the contractor corrects all identified Category II safety deficiencies. (SRs 391, 463, 286, 207, 133, 404, 169, 357, 533, 032, 098, 113)

c. Ensure safety warnings and safe equipment power-down/power-up instructions are incorporated into all applicable maintenance procedures in the technical data (SRs 168, 286, 285).

3.11 OBJECTIVE ES-11. Assess factors impacting the interoperability of NEXRAD with existing and planned systems.

3.11.1 Method. Six test team specialists and six software evaluators reviewed contractor technical documents to assess the capability of meeting existing and future interoperability requirements. Contractor interface control documents were compared to corresponding standards with respect to accuracy and level of detail. The test team documented identified deficiencies as service reports and assessed the impact of the deficiencies on NEXRAD's interoperability with existing and planned systems. In addition, the test team addressed NEXRAD's ability to manually interoperate (nonelectronically) with existing weather information systems/networks.

3.11.2 Results and Conclusions.

3.11.2.1 The test team found there was inadequate information in the interface control documents to interface planned systems with PUES communications ports using the Standard Formats for Weather Data Exchange Among Automated Weather Information Systems, FCM-S2-1986 (Redbook) data formats. In addition, the specialists identified several other concerns with the use of PUES ports based upon a review of these documents. First, there would be limited flexibility in the frequency and type of products available over the PUP PUES port. Second, decoding of RPG-formatted products and reformatting them into Redbook format would likely require significant computer memory resources. Third, some Redbook-formatted products were estimated to require more than 2 minutes to transmit. This would limit the number of products that can be transmitted across a PUES port for each volume scan.

3.11.2.2 The test team specialists also found other documentation deficiencies that applied to all of the communication ports. First, information was not logically organized in the Communication Interface User's Guide (CIUG) and interface control documents (ICDs). The same topics were scattered over several different documents, but none of the documents contained sufficient information to stand alone. Second, the ICDs did not clearly describe in detail the standard communication protocol implementation. A description of the NEXRAD products available for each interface, and the format used to transmit them, was missing. The ICDs had inadequate detail and description of the transport, message format, and data link layers of the communication protocol. In several places, information concerning the physical layer was marked "To be determined." Third, deviations from accepted standards and protocols were not clearly noted or explained. The documentation did not explain why the Advanced Data Communication Control Procedures standard "flag" definition had a different value for the wideband interface than for the narrowband interfaces. Fourth, there were various inconsistencies in the CIUG and the ICDs. The Unit/PUES ICD gave default timing values while the Unit/Principal and Other Users ICD did not. Formatted commands and responses did not match in some of the ICDs. Also, there was a conflict with block formats and field identifiers in the CIUG. A location was specified for a message code value, but in several block formats there was something else specified for that location. Although there appeared to be sufficient information to interface systems with the "Other Users" ports on NEXRAD, the deficiencies noted above made it difficult and time-consuming to find and organize this information.

3.11.2.3 For interoperability with existing systems, DOC operators were able to effectively use the data from the hard copy device to support their weather warning verification process.

3.11.3 Recommendations.

3.11.3.1 For JSPO:

a. Provide a stand-alone interface document for each NEXRAD interface. (SRs 407, 526, 302)

b. Clearly document deviations from accepted standards and protocols. (SRs 261, 486)

3.11.3.2 For users: Investigate if the identified concerns associated with the PUES port will adversely impact its intended use.

3.12 OBJECTIVE S-12. Assess NEXRAD reliability.

3.12.1 Method. The measure of NEXRAD reliability was MTBM (total corrective). The test team calculated MTBM (total corrective) as well as MTBM (inherent), MTBM (induced), and MTBM (no defect) for both the system and the individual functional areas. The following definitions were used for these calculations:

a. Malfunction. An overall category of problems requiring a maintenance response. Failures and critical failures (both are defined in objective S-14) and LRU malfunctions are subsets of this category.

b. Inherent Malfunctions. A malfunction resulting from internal design and manufacturing characteristics.

c. Induced Malfunctions. A malfunction resulting from other than internal design and manufacturing characteristics. For example, improper maintenance, operator error, or failures due to malfunction of associated equipment.

d. No-Defect Maintenance Event. A maintenance event which has no confirmed malfunction.

3.12.1.1 The test team performed 24-hour-a-day organizational-level maintenance and collected reliability data during both Part A and Part B of IOT&E(2). However, only data collected during Part B and reviewed and categorized by the Data Reduction and Analysis Working Group (DRAWG) were used for MTBM calculations. Operational times and maintenance data were collected using MDC forms and operations logs. These data, along with DRAWG categorizations, were entered into the Micro-Omnivore logistics data base. The DRAWG reviewed all maintenance data for failures that required a maintenance response and assessed whether the failures experienced were inherent, induced, or no-defect maintenance events.

3.12.2 Results and Conclusions. The demonstrated MTBM (total corrective) for the NEXRAD system was 25.3 hours. The MTBM (total corrective) and the number of inherent, induced, and no-defect maintenance events for the system and each functional area are given in table III-4.

Table III-4

Reliability Data

Category	RDA	RPG	PUP	System
Maintenance Events				
Inherent	26	20	27	73
Induced	1	0	7	8
No-Defect	2	3	1	6
Total	29	23	35	87
MTBM (total corrective) (hours)	53.1	78.6	125.6	25.3

Notes: (a) Categorizations by functional area and maintenance event types determined by DRAWG.

(b) PUP maintenance events were collected from the three operational PUPs at the WSFO, Tinker AFB BWS. and FAA Academy. The PUP data were averaged for MTBM determinations.

3.12.2.1 The demonstrated MTBM (inherent) for the NEXRAD system was 29.3 hours. The MTBM (induced) and MTBM (no-defect) were not computed because of the limited number of induced malfunctions and no-defect maintenance events which occurred in each functional area.

3.12.2.2 Four reliability problem areas were identified. The preproduction transmitter required 19 maintenance events in Part A and 12 in Part B. The RPG required 1 maintenance event in Part A and 12 events in Part B to restore operations following power transitions. The three graphics processors required 12 maintenance events in Part A and 10 in Part B to correct graphic lockups. The four archive optical disk drive units required 8 maintenance events in Part A and 5 in Part B, primarily to either remove a jammed disk or remove and replace the entire disk drive unit. For detailed, additional reliability data see appendix D.

3.12.2.3 Impacts on Maintenance Workload:

a. The agencies' primary weather radars (the WSR-57 and FPS-77) have a demonstrated reliability approximately 10 times greater than the demonstrated reliability of the NEXRAD tested and a demonstrated mean time to repair (MTTR) (for 73 inherent malfunctions) similar to NEXRAD's. For the WSR-57 the mean time between failure (MTBF) was 14 days (based on a 1-year average, October 1985 through September 1986); NEXRAD was 1.2 days. For the FPS-77 the mean time between critical failure (MTBCF) was 18.5 days (based on a 2-year average, July 1987 through June 1989); NEXRAD was 1.9 days. The MTTR was 2.5 hours, 4.4 hours, and 3.5 hours for the WSR-57, FPS-77, and NEXRAD, respectively. The decreased reliability and the similar maintainability indicated that NEXRAD will increase the workload for technicians at maintenance locations responsible for an entire NEXRAD system. In many cases, one or more trips per maintenance event, to a remotely located RDA (up to 35 miles away), will be required to restore system operations. If both the RDA and RPG are remotely located, the system will have an even greater impact on maintenance workload because multiple trips may be required to obtain additional spares, materials, etc.

b. For PUP only sites, NEXRAD's demonstrated reliability and repair times in comparison with those of the agencies' primary radar showed that the NEXRAD system may have little or no impact on maintenance workload. However, maintainers still expressed concern about the repeated maintenance responses for graphics processor problems, primarily corrected through only a reseating of the processor hard cursor card.

3.12.2.4 Operator Reset/Restart Actions. The operators were required to perform 5 software resets/restarts on the RDA, 22 on the RPG, and 400 on the three operational PUPs. These operator actions occurred in Part A and Part B and were not included in reliability and maintainability calculations because no maintenance actions (as categorized by the DRAWG) were required. The majority of the operator resets/restarts at the PUPs were required to correct graphics processor lockups.

3.12.3 Recommendations. For JSPO:

a. Assess transmitter reliability and take appropriate action to correct recurring transmitter problems. (SRs 098B, 002B, 112A, 149)

b. Correct the problems associated with the RPG failing to recover automatically after power transfers. (SRs 317, 087B)

c. Determine the underlying causes of Ramtek graphics problems and take appropriate action to eliminate recurrence. (SRs 083, 301, 418)

d. Correct the problems associated with the optical disk drive unit and archive functionality. (SRs 368, 061, 332, 051)

e. For all other failures, determine the failure sources and take corrective action.

3.13 OBJECTIVE S-13. Evaluate NEXRAD maintainability.

3.13.1 Method. During IOT&E(2) the test team performed organizational-level maintenance using the PTM and provided support equipment. The test team recorded data on all failures, to include associated maintenance times for troubleshooting (isolation), repair, and verification of corrective action. However, only data collected during Part B, reviewed and categorized by the DRAWG, was used for the maintainability calculations. The test team collected maintainability data using MDC forms and operations/maintenance logs. These data, along with the DRAWG categorizations, were entered into the Micro-Omnivore logistics data base. Based on the DRAWG categorizations, the test team calculated the MTTR for LRU malfunctions, hardware failures, and all inherent malfunctions, the percentage of LRU malfunctions isolated using primary fault isolation (PFI), and the mean time to troubleshoot (MTT).

3.13.1.1 The test team collected data on the percentage of failures that were identified by on-line fault monitoring, along with information on cannot duplicate (CND) events and false alarms, to assess the adequacy of system status monitoring. The test team also compiled data to assess the adequacy of logistic support elements, including training, technical data, diagnostics, support equipment, spares, and facilities, as it applied to both scheduled and unscheduled maintenance actions. This was accomplished primarily by test team observations and maintainability questionnaires.

3.13.1.2 The primary measure of maintainability was MTTR (for LRU malfunctions). The primary measures of NEXRAD fault isolation performance were the percentage of LRU malfunctions isolated to one LRU using PFI and the percentage of LRU malfunctions isolated to three or fewer LRUs using PFI.

3.13.2 Results and Conclusions. NEXRAD did not meet the users' requirements for MTTR, PFI isolation to a single LRU, or PFI isolation to a group of three or fewer LRUs (see table III-5).

Table III-5

LRU Maintainability

	Users' Requirements	Results
MTTR	0.5 hours	9.0 hours
PFI to single LRU	80%	50%
PFI to 3 or fewer LRUs	95%	57%

NOTE: The MTTR was computed based upon the 16 LRU malfunctions that occurred during IOT&E(2) Part B. Two of the 16 were not used in computing the PFI values above, because the use of PFI was not involved.

3.13.2.1 For the 29 hardware failures during Part B (including the 16 LRU malfunctions used above), the functional area and system MTTR and MTT are given in table III-6. The test team could not repair 3 of the 29 system hardware failures (including 2 of the LRU malfunctions) and had to request field maintenance services in accordance with the Contractor Support Services Plan (CSSP).

Table III-6

Hardware Maintainability

	RDA	RPG	PUP	System
MTTR (hours)	18.0	0.2	2.0	6.9
MTT (hours)	16.0	0.0*	1.4	6.0

*Less than 1 minute of troubleshooting time was required for the 1 RPG hardware failure.

3.13.2.2 For the 73 inherent malfunctions during Part B (including the 29 hardware failures used above), the functional area and system MTTR and MTT are given in table III-7.

Table III-7

Inherent Failures Maintainability

	RDA	RPG	PUP	System
MTTR (hours)	7.1	1.0	1.9	3.5
MTT (hours)	6.1	0.7	1.5	2.9

3.13.2.3 The three primary deficiencies that contributed to the system MTTR were training (see objective ES-9), the PTM (see objective S-15), and PFI.

3.13.2.4 PFI contributed to the fault isolation process in 73.9 percent of the troubleshooting actions. When PFI did contribute, the MTT was 3.1 hours. In those cases where PFI did not contribute, the MTT was 19.2 hours. The concept of PFI for the NEXRAD system can be divided into three areas: (1) PTM fault isolation flowcharts, (2) on-line diagnostics, and (3) off-line diagnostics. During IOT&E(2), all were inadequate for isolating faults in the NEXRAD system within the maintenance concept.

a. The PTM fault isolation flowcharts had limited usefulness as the primary fault isolation tool. The flowcharts were incomplete and ambiguous and they contained numerous errors. For the majority of maintenance events, the flowcharts led technicians to the incorrect area or failed to isolate the fault. In many cases, the flowcharts indicated failed LRU(s) that, when replaced, did not correct the problem. The maintainers' assessment indicated that the flowcharts must be supplemented by quality training and comprehensive documentation. In addition, technical procedures (secondary fault isolation) to augment and back up the PFI (to allow maintenance personnel to isolate faulty LRUs using standard support equipment) did not exist.

b. The on-line diagnostics use of built-in test (BIT) and self-diagnostic logic seemed to be sufficiently integrated within the system; however, several identified problems limited its benefit. First, the documentation failed to provide adequate information on error codes/messages, and a thorough description of self-diagnostic tests was not provided. Second, BIT was not sufficient to isolate malfunctions to a specific LRU. Finally, the number of system status messages/alarms, many of which were false alarms, negated their usefulness as a fault isolation tool.

c. Off-line diagnostics were not sufficient to isolate faults. The Radar Data Acquisition System Operational Test (RDASOT) had several baseline failure indications. Also, when using RDASOT, failure indications often did not indicate further maintenance actions and faults could not be isolated through further use of the flowcharts. Adequately detailed documentation for each off-line diagnostic was not available.

3.13.2.5 The system MTTR was greatly impacted by the average length of the RDA restoration times. The demonstrated RDA MTTR of 18.0 hours was attributable to several key maintainability issues. Other than the diagnostics problems noted above and the PTM problems (see objective S-15), the most significant problem was that technicians were not provided thorough training on RDA functionality, theory of operation, the use of complex test equipment, and key software and hardware interrelationships. In three of the RDA failures, the test team could not repair the system and requested field maintenance services in accordance with the CSSP. In these cases the MTTR of 49.9 hours included both test team and contractor maintenance actions. When the test team was able to repair RDA failures, the MTTR was 1.6 hours.

3.13.2.6 The test team completed 54 PMIs during IOT&E(2) Part B. The actual time required to complete these PMIs totaled 8.1 hours. The time requirements listed in the PTM for these PMIs totaled 7.3 hours. The test team estimated downtime for PMIs will be 33.2 hours per year compared to 24 hours required by the maintenance concept. This was based on the 30.4 hours per year specified in table 5-3.1 of the PTM and the 2.8 hours per year for PMIs which will require downtime but were not specified as such in the PTM (i.e., operational check of Micro Junior control panel, the transmitter pulse width check, and the Klystron spectrum check).

3.13.2.7 The on-line system status monitoring system generated status alarms/messages so frequently that PUP and UCP operators often ignored them, even though some indicated "maintenance mandatory." Under minimal load conditions, with four dedicated PUPs connected to the system, approximately 45 system status alarms/messages were generated per hour and displayed at the UCP. Many of these alarms/messages reflected communications connects/disconnects, narrowband overload/loadshedding, and transmitter peak power low. Under a representative test load of 19 users, system status alarms/messages in excess of 90 per hour were noted.

a. Because of the number of system status messages, the test team was unable to investigate all alarms/messages to determine which were unconfirmed fault indications (UFIs). The test team found that sometimes the system operated without generating any UFIs; however, the operator usually received at least one UFI per hour at the UCP. When the RDA was unstable, operators noted as many as seven UFIs in 1 hour. Most of these indicated a degradation in the transmitter/receiver circuitry; however, many indicated hardware failures. As a result of inadequate training, documentation, and the large number of system status alarms/messages, the operators often did not know what actions to take or what effect the alarms/messages may have had operationally.

b. On-line system status monitoring identified 69 percent of the failures that required maintenance actions during IOT&E(2) Part B. However, as noted above, operators often ignored the alarms until they noted system degradation. The system status monitoring normally did not help in the cases of Ramtek graphics processor lockups because the operator would realize the graphics were inoperable usually about 20 seconds before the system indicated a problem existed.

c. The percentage of organizational CND maintenance events during IOT&E(2) Part B was 7.9 percent. The mean time spent troubleshooting CNDs was 0.5 hour. This decreased from the values determined for Part A (10.5 percent and 1.0 hour, respectively). Of the six CND events experienced during Part B, two involved RDA alarms which cleared without maintenance intervention. Two other times the operator received archive error messages, but the archive was operational before maintenance technicians arrived. The last two were RPG communication alarms; one the technicians were unable to duplicate, the other the system recovered automatically before maintenance responded.

3.13.2.8 Another key maintainability issue was that maintenance technicians could not verify system calibration or accuracy. The RDA calibration described in the PTM was complex, erroneous, and confusing. It primarily consisted of checking test signal path losses and did not provide an end-to-end RDA calibration. Maintenance technicians could not verify what effect changing the calibration parameters had on the system and could not verify that the system was correctly monitoring transmitter output power. The RDA calibration file, to which the technicians had access, contained more than 200 adaptable parameters. However, the documentation did not show the nominal range of parameter values, how each parameter should be used, when or why it should be changed, or how changing the parameter would affect system calibration. After receiver alignments were completed, maintenance technicians were unable to verify if correct reflectivity and velocity values were displayed by the system. During the Pedestal Alignment Check (suncheck), used to verify system positional accuracy, the system would not accept the updated correction factors and the technicians were not provided enough information to complete the check.

3.13.2.9 The test team documented, in service reports, deficiencies that impacted system accessibility and ease-of-maintenance. Besides technical data deficiencies, the two most common problems noted were missing or incorrect labeling/reference designators and the poor design of cable routing/terminations within the equipment cabinets. However, two of the most significant ease-of-maintenance problems noted were the lack of storage space in the generator shelter, and the lack of storage and work space for maintenance activities in the RDA shelter.

3.13.2.10 Skill levels of agency technicians that participated in IOT&E(2) ranged from a 5-level technician with 4 years of experience to a journeyman with 36 years of experience. With the training, technical manuals, and diagnostics provided for IOT&E(2), the test team agency technicians were not able to maintain the system within the required time to repair.

3.13.3 Recommendations. For JSPO:

a. Ensure the technical data are adequate to maintain the system. (SRs 014, 265A, 129, 440, 138A, 227, 328, 384, 138, 286, 420, 544, 251, 543, 403, 239, 169A, 285, 416, 439, 077)

b. Resolve all training issues impacting maintainability (see objective ES-9).

c. Ensure on-line fault monitoring is improved by reducing the frequency of system status alarms/messages and by eliminating unconfirmed fault indications. (SRs 531, 072B, 006B, 129, 530, 168A, 437, 138A, 009A, 139A, 104A, 439)

d. Ensure the system on-line BIT and self-diagnostics are improved to consistently and accurately isolate faults within specific areas/subsystems. (SRs 072B, 439, 212, 248, 300, 057, 541, 255A, 386, 467, 213)

e. Ensure all off-line diagnostic tests are improved so that LRU malfunctions can be isolated within the criteria specified by the maintenance concept. (SRs 251, 169A, 264, 018, 008, 378, 170, 048, 094, 064, 066, 117, 245, 151, 082, 141, 368, 065, 471, 319, 470, 469)

f. Provide sufficient storage and workspace for maintenance in the RDA and generator shelters. (SRs 187, 047B, 096)

g. Ensure all equipment/LRUs are correctly labeled and cable routing and terminations are designed for ease-of-maintenance. (SRs 098, 159, 055, 208A, 124, 125A, 268, 036, 132, 262, 312, 314, 038, 034B, 292, 347, 144, 472, 134, 232, 070B, 148, 099, 045, 030, 156, 145, 105, 054, 116, 171, 114)

h. Provide secondary fault isolation procedures to augment and back up the PFI. (SR 169A)

3.14 OBJECTIVE S-14. Evaluate NEXRAD availability.

3.14.1 Method. The NEXRAD system availability was measured in terms of full system availability and degraded system availability.

3.14.1.1 The test team collected availability data during both Part A and Part B; however, only data collected during Part B and reviewed and categorized by the DRAWG were used for availability calculations. The test team collected data on operational hours, failures, maintenance actions, and downtimes on MDC forms and operations logs. These data, along with the DRAWG categorizations, were entered into the Micro-Omnivore logistics data base. As appropriate, the DRAWG determined whether each failure impacted availability and whether it was a critical or noncritical failure.

3.14.1.2 The test team calculated full system and degraded system operational availability (A_O) for the system as well as for each functional area. Based on failures requiring a maintenance response, A_O was computed using inherent failures, as well as those no-defect and induced failures attributable to equipment design. The following definitions and methods were used when collecting and analyzing operational availability data:

a. Full system operational availability was based on the capability to perform the functions, except Archive I and II, shown in the NEXRAD Unit Operational Functional Flow Diagram (figure 3.4 of the 1984 NEXRAD Technical Requirements (NTR) included here as figure III-1). Thus, any failure which prevented the system from performing any of the functions in figure III-1 (except Archive I and II) impacted full system A_O.

b. Degraded system operational availability was based on the capability to perform the following critical functions outlined in the NTR, figure 3.4 and table 3.6 (key operational functions and subfunctions, respectively): 1 (transmit/receive), 2 (signal processing-reflectivity), 4 (base product generation/distribution), and 8a (display locally stored base products). Thus, any critical failure which prevented the system from performing any of these four critical functions impacted the degraded system A_O.

3.14.2 Results and Conclusions.

3.14.2.1 The NEXRAD full system operational availability of 86.3 percent did not meet the users' requirement of 90 percent.

3.14.2.2 The NEXRAD-degraded system operational availability of 88.2 percent did not meet the users' requirement of 96 percent.

3.14.2.3 During IOT&E(2) Part B, the system experienced 70 inherent failures (hardware and software) which impacted availability; 47 were critical. The DRAWG categorized all failures based on failure definitions in the NTR.

a. Since the integrated logistics support was not available at the beginning of IOT&E(2), the system availability calculations were based on the assumptions in appendix C of the NEXRAD Maintenance Concept. These assumptions include a 95-percent sparing level (spares available on-site to repair 95 percent of the LRU failures) and a 24-hour response time for the remaining 5 percent of the LRU failures. This resulted in a constant administrative and logistics delay time of 2.2 hours (for LRU replacement) or 1.0 hours (for non-LRU replacement) being added to each maintenance action as validated by the DRAWG.

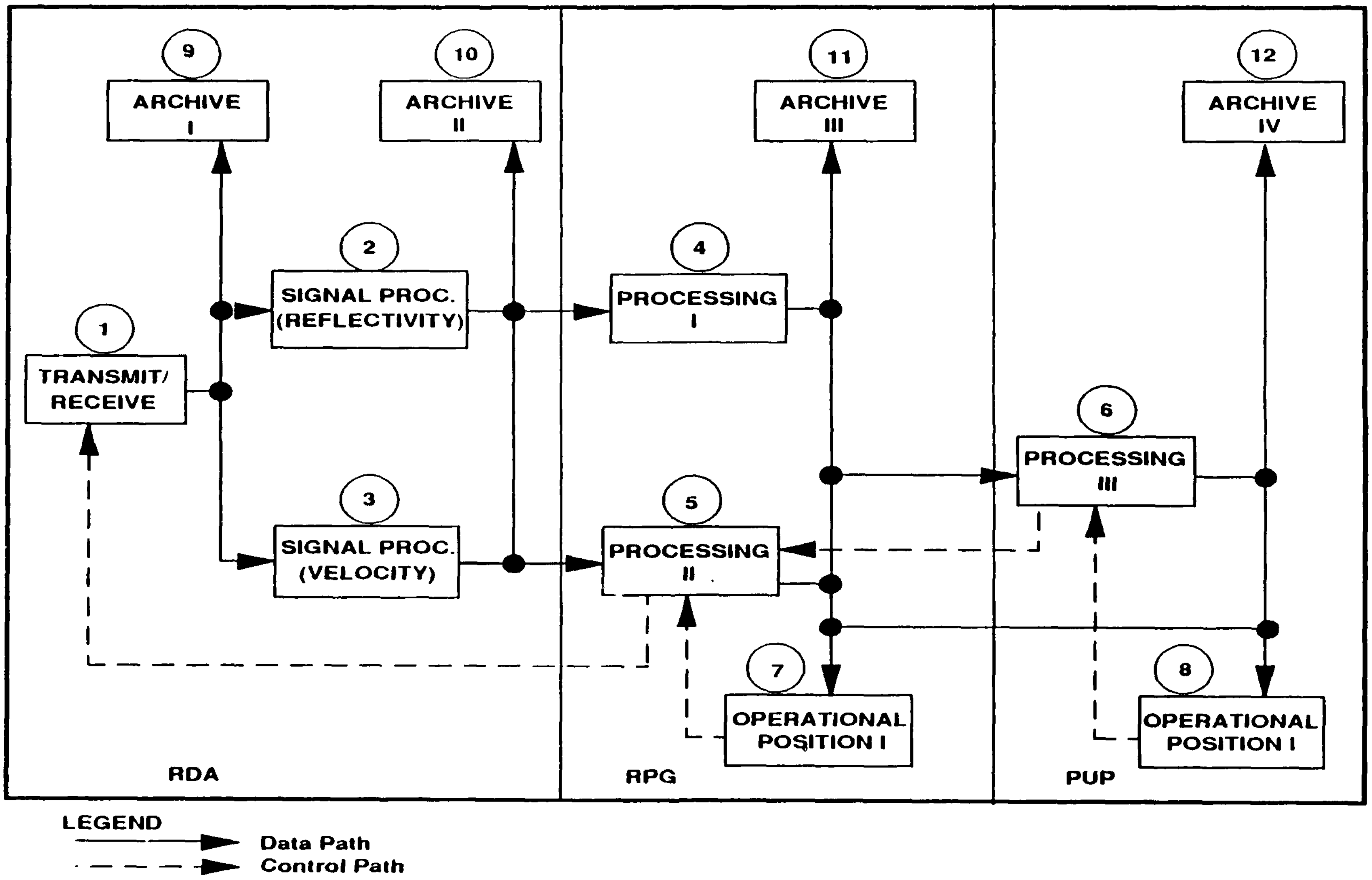

Figure III-1. NEXRAD Unit Operational Functional Flow Diagram

b. In accordance with the definitions in the test plan, the downtime calculations included the repair time for all failures (not just the LRU failures) during Part B. The operational availability data, as well as the reliability and maintainability data used to compute the availability, for the system and functional areas are given in table III-8.

Table III-8

RM&A Data

Area	MTBF (hours)	M (hours)	A_o(full) (%)	MTBCF (hours)	Mcf (hours)	A_o(degraded) (%)
System	30.7	4.9	86.3	44.8	6.0	88.2
RDA	64.2	9.0	87.7	96.3	11.7	89.2
RPG	90.4	2.0	97.8	120.5	2.2	98.2
PUP	169.0	3.2	98.1	274.6	3.9	98.6

Where:

MTBF is the mean time between failure
MTBCF is the mean time between critical failure
M is the mean downtime
Mcf is the mean downtime for critical failures
A_o(full) is the full system operational availability
A_o(degraded) is the degraded system operational availability

NOTE: After the computations were performed, the results were rounded to a single decimal point.

3.14.2.4 As shown above, the RDA availability had the greatest impact on system availability. The largest detractor from the RDA availability was the preproduction transmitter reliability and maintainability problem (11 transmitter failures with a 10.4-hour MTTR). Although the RPG failures associated with power transitions did not have a significant impact on overall system availability, the timing of these events critically degraded the effectiveness of NEXRAD as an aid in providing required weather support. Many times in severe weather episodes, when the operators needed the system to support critical weather warning operations, the system was not available. When the operators considered the overall system performance, including the impact of availability, for supporting the mission requirements, they stated that the system did not meet their minimum operational requirements.

3.14.3 Recommendations.

3.14.3.1 For JSPO:

a. Ensure RDA reliability and maintainability problems, particularly with the transmitter, are resolved. (SRs 098B, 206, 002B, 112A, 420, 207, 354, 096, 026, 149, 036, 078, 033B, 267, 483, 353, 185, 327, 073, 095, 118)

b. Ensure RPG power transfer problems are resolved. (SRs 317, 087B, 166)

c. Ensure overall system reliability and maintainability problems are resolved (see objectives S-12 and S-13).

3.14.3.2 For JSPO and users: *Ensure sparing level is adequate to meet availability requirements.*

3.15 OBJECTIVE S-15. Assess the adequacy of logistics support.

3.15.1 Method. The provisioning process for support equipment and spares will not be completed until mid-1990. Therefore, a limited, contractor-proposed, JSPO-approved package of support equipment and spares was used for IOT&E(2). Also, since the production technical orders are not deliverable until 1990, the PTM was used during the test. Deficiencies in the PTM that adversely affected the performance of maintenance were documented. The test team also documented other discrepancies in the technical manuals that did not affect IOT&E(2) maintenance actions. The test team assessed the sufficiency of support equipment by using support equipment as prescribed in the PTM for maintenance activities. The test team assessed the adequacy of on-site spares by collecting hardware failure and parts consumption data. Agency provisioning, equipment, and logistics specialists reviewed logistics support planning documents to address the adequacy of planned provisioning to support their agencies' requirements.

3.15.2 Results and Conclusions.

3.15.2.1 The PTM and the JSPO list of required support equipment did not agree. The test team identified 20 items of support equipment required by the PTM for maintenance actions which were not on the JSPO list. These deficiencies limited the maintainers' ability to perform or complete scheduled and unscheduled maintenance actions.

3.15.2.2 The JSPO-provided complement of on-site spares was not adequate to maintain the system in accordance with the maintenance concept. Therefore, the provisioning process must identify a sparing level that is better aligned to the agencies' requirements than the contractor-proposed, JSPO-approved package of spares that was provided for IOT&E(2). Of the 56 LRU replacements required during IOT&E(2), 16 spares (28.6 percent) were on site and the remaining 40 spares (71.4 percent) had to be ordered. In addition, the fault isolation procedures often required the technician to obtain and insert multiple spare LRUs to isolate faults. Unless the required spares were on site, the test team could not proceed with fault isolation using the PTM flowcharts until the spares were received. Thus, system operational effectiveness was severely impacted while waiting for spare LRUs not on site. Also, upon receipt, 11 of the 40 contractor-provided spares were incompatible with the unit being tested in IOT&E(2). The majority of the incompatible LRUs were for the RDA.

3.15.2.3 The unanimous opinion of the maintenance technicians was that the PTM, which includes the vendor manuals, was inadequate for training and for maintaining the NEXRAD system.

a. Although the contractor's latest PTM revision (Revision C.1) was an improvement over the version available at the beginning of test, it was still seriously deficient in many areas. The PTM was incomplete and ambiguous and contained numerous errors. As a result, maintenance technicians stated that the PTM was inadequate for 83 out of 159 maintenance actions documented on maintenance incident questionnaires during IOT&E(2). Additionally, of the 72 PMIs scheduled during Part B, 42 had documented technical data deficiencies; 17 of these 42 could not be completed.

b. The PTM fault isolation flowcharts had limited usefulness as the primary fault isolation tool. The flowcharts were incomplete and ambiguous, and they contained numerous errors. For the majority of maintenance events, the flowcharts led technicians to the incorrect area or failed to isolate the fault. In many cases, the flowcharts indicated failed LRU(s) that, when replaced, did not correct the problem. The maintainers' assessment indicated that the flowcharts must be supplemented by quality training and comprehensive documentation. In addition, technical procedures (secondary fault isolation) to augment and back up the PFI (to allow maintenance personnel to isolate faulty LRUs using standard support equipment) did not exist.

c. The PTM did not include procedures for the organizational-level technician to verify that the system was properly calibrated. The RDA calibration alignment, described in the PTM, was not a true RDA calibration but a check of the path losses. In addition, because of inadequate procedures and functionality, the test team could not complete the important Pedestal Alignment Check (suncheck) to verify system positional accuracy.

d. The planned cadre training will likely be ineffective if the technical manuals do not have a major upgrade prior to its start. Until the technical manuals are complete and the ambiguities and errors are removed, the NEXRAD system will probably not be maintainable in accordance with the NEXRAD maintenance concept and operational effectiveness will likely be adversely impacted.

3.15.3 Recommendations.

3.15.3.1 For JSPO and users:

a. Ensure the technical data identify all support equipment required to complete organizational-level maintenance. (SRs 202, 078, 023, 483, 209, 192, 536, 107, 236)

b. Ensure sparing level is adequate to meet availability requirements.

3.15.3.2 For JSPO:

a. Ensure spares provided are compatible with the fielded unit (e.g., limited production spares for limited production equipment). (SRs 206, 480, 099)

b. Ensure the technical data are significantly upgraded, validated, and verified well before the cadre training to meet both the theory and hands-on training requirements. (SRs 014, 265A, 129, 440, 138A, 227, 328, 384, 138, 286, 420, 544, 251)

c. Ensure all alignments and PMI procedures that are required to maintain the NEXRAD system are correct and included in the technical data. (SRs 440, 164A, 384, 420, 169, 354, 285, 197, 355, 482, 005, 112, 412, 535, 312, 353)

d. Ensure the NEXRAD system technical data are adequate for a 5-level maintenance technician to maintain NEXRAD in accordance with the maintenance concept.

e. Provide secondary fault isolation procedures to augment and back up the PFI. (SR 169A)

3.16 OBJECTIVE S-16. Evaluate NEXRAD software maintainability.

3.16.1 Method. Selected software documentation was evaluated at the CPCI level for its overall contribution to the maintainability of the NEXRAD software. Corresponding NEXRAD software source listings were evaluated on a module-by-module basis. This evaluation measured the extent to which the software design, as reflected in the documentation and software source listings, possessed good software maintainability characteristics.

3.16.1.1 The AFOTEC software maintainability evaluation technique described in AFOTECP 800-2, volume III, was used for this evaluation. Ten trained software evaluators completed standard questionnaires for the documentation and selected modules for four CPCIs.

3.16.1.2 The evaluators were provided a software maintainability evaluation guide, which contained the questionnaires, and were prebriefed on the evaluation procedures. Although the questionnaires required standardized answers, the evaluators included written comments as they deemed appropriate.

3.16.1.3 The software test team evaluated the documentation and source listings for CPCI-01 (RDA Status and Control), CPCI-03 (Radar Product Generation), CPCI-04 (Product Display), and CPCI-28 (Performance Monitoring and Data Reduction). Based on the response scale in table III-4 of 1 (low) to 6 (high), averages of 3.5 and above indicate generally favorable maintainability characteristics, and averages below 3.5 indicate generally unfavorable characteristics. Significant deficiencies identified by the test team were reported as service reports.

3.16.2 Results and Conclusions. Overall, the documentation and source listings met the user's requirement of 3.5. The average scores for the four CPCIs are shown in the tables III-9 and III-10. Each of the seven characteristics in the tables is an average of the questions that relate to that characteristic. The overall score is the average of all questions.

Table III-9

Documentation Evaluation Results

Characteristic	CPCI-01	CPCI-03	CPCI-04	CPCI-28
Modularity	4.1	4.3	4.3	3.8
Descriptiveness	3.3	3.5	3.4	3.6
Consistency	3.9	3.8	3.8	3.9
Simplicity	4.2	4.3	4.4	4.7
Expandability	3.3	3.5	3.6	3.8
Testability	2.9	3.3	3.1	3.0
Traceability	3.4	3.1	3.3	3.1
Overall	3.6	3.7	3.7	3.7

Table III-10

Source Listings Evaluation Results

Characteristic	CPCI-01	CPCI-03	CPCI-04	CPCI-28
Modularity	5.4	5.3	5.3	5.2
Descriptiveness	4.0	4.0	4.1	4.2
Consistency	4.0	3.9	3.9	4.2
Simplicity	5.5	5.3	5.3	5.1
Expandability	5.0	5.0	5.0	4.8
Testability	4.5	4.4	4.5	4.2
Traceability	3.3	3.0	3.0	3.4
Overall	4.6	4.5	4.6	4.6

3.16.2.1 Documentation. Significant problems were identified during the documentation evaluation. As shown in the documentation evaluation results in table III-9, the characteristics of testability and traceability did not meet the requirement of 3.5 for any of the four CPCIs. The characteristic of descriptiveness did not meet the requirements for two of the four CPCIs evaluated. Expandability did not meet the requirement for CPCI-01. The deficiencies discussed below detail the primary reasons why these documentation characteristics averaged below 3.5.

a. The Computer Program Product Specifications (C5) documents were the most significant detractors. The C5s were inadequate for each of the CPCIs evaluated. It was difficult, time-consuming, and sometimes impossible to find module descriptions, data flow descriptions, and calling sequences. For example, the 1,986-page C5 document for CPCI-01 had a 2-page table of contents that was not sufficiently detailed, no index to find the references to a module, and no glossary of unique terms.

b. The data dictionaries were the second major deficiency. They were also inadequate for each CPCI evaluated. Each of the data dictionaries was missing data element names, had no naming convention to distinguish global data names from local names, had data elements from COMMON Blocks that did not have the name of the COMMON block listed, made no distinctions between data elements being set or used, and had inaccurate data type information (e.g., whether global, common, or local and whether a scalar, array, or literal). For example, on one occasion, trained software evaluators spent approximately 3 days unsuccessfully trying to locate information and trace the data flow of a data element.

c. A third deficiency was that the version description document (VDD) for each CPCI did not contain adequate descriptions. The files needed to compile and link a CPCI were not fully specified, and other CPCIs associated with or used by a CPCI were inadequately specified. Software evaluators took 4 days during IOT&E(2) attempting to build the CPCI-04 software. They were unsuccessful primarily because the VDD for CPCI-04 did not provide adequate compile and link information.

d. Fourth, it was the software evaluators' opinion that adequate test information was not built into the software documentation. The evaluated CPCI documentation did not contain sufficient descriptions of low-level (module) testing that would be used to verify software changes. There was only limited descriptions of higher level (CPCI and functional area) testing. The software debug tools available to the test team for software testing were not described in the documentation.

3.16.2.2 Source Listings. The source listings were determined to have simple, expandable, and modular characteristics. These characteristics enhanced the maintainability of the software. However, the characteristic of traceability did not meet the requirements for any of the four CPCIs evaluated. (See table III-10.)

a. An inadequate preface block in each module's source listing was the major deficiency that adversely impacted traceability. Of the 179 modules evaluated, 165 modules had errors, inconsistencies, or incomplete information. The data element descriptions in the preface block listed elements that were not used in the module, did not list elements that were used in the module, and often incorrectly described data elements that were listed. The description of the module's function was either incorrect, inadequate, or missing. The program design language (PDL) did not always match the implemented source code. A list of modules which call the evaluated module was missing from the preface block. The list of modules that the evaluated module called was often incorrect. Inadequate data element descriptions in the preface blocks caused invalid information to be used in the data dictionaries. Unless these deficiencies in the preface block are corrected, the data dictionary program cannot produce accurate data dictionaries.

b. Another deficiency with the source listings was that imbedded comments in the source code were often just a repeat of the PDL. The software evaluators usually found no extra information in the comments. This limited the understanding of the source code, especially when trying to verify complicated math algorithms in a module.

3.16.2.3 The documentation and source listings deficiencies noted above severely degraded the ability to locate and trace information needed to solve software problems. Software evaluators stated that the documentation would require a major upgrade before it would be adequate for use in software maintenance. The deficiencies in the preface blocks and source code of source listings identified above made it difficult and sometimes impossible for software evaluators to trace data element names, data flow, and math algorithm implementations from the source code to the documentation. Although the documentation and source listings met the users' minimum requirements as evaluated using the standard questionnaires, additional personnel and other resources will likely be necessary to maintain and update the NEXRAD software unless the above identified deficiencies are corrected.

3.16.3 Recommendations. For JSPO:

a. Ensure the contractor reviews and corrects, for all modules, the deficiencies associated with the preface blocks and imbedded comments of the source listings. (SRs 352, 496, 497, 401)

b. Correct the deficiencies with the software C5 documentation. (SRs 335, 493, 290, 289, 492, 374, 491, 362, 342, 498, 334, 316)

c. Correct the deficiencies with the data dictionaries. (SR 323)

d. Ensure each version description document adequately describes each CPCI. (SRs 494, 341)

3.17 OBJECTIVE S-17. Assess the adequacy of planned and existing NEXRAD software support resources (SSR).

3.17.1 Method. The SSR assessment methodology described in AFOTECP 800-2, volume V and the life cycle management assessment methodology described in AFOTECP 800-2, volume II were used for this assessment.

3.17.1.1 The SSR are those resources required to accomplish software modifications for NEXRAD. These resources include the computers and associated supporting software, support facility layout, personnel, training, test tools, distribution procedures, and hardware/software documentation required to accomplish, test, and implement software changes.

3.17.1.2 The test team assessed whether the life cycle management plans addressed support procedures for updating and maintaining configuration management. The draft Integrated Logistics Support Plan (ILSP), Software Management Plan (SMP), and the Computer Resource Management Plan (CRMP) were used as the major planning documents in this assessment.

3.17.1.3 Ten trained software evaluators completed the questionnaires for AFOTECP 800-2, volumes II and V. The Deputy for Software Evaluation (DSE) briefed the evaluators on the questionnaires and the assessment procedures. The DSE debriefed the evaluators after completion of the questionnaires to resolve any uncertainties and to ensure that all evaluators had fully addressed each question.

3.17.2 Results and Conclusions.

3.17.2.1 The OSF was hiring personnel with adequate experience and skills and was working to obtain more facility space to perform various software-related functions which were not yet well defined. At the end of IOT&E(2), the NEXRAD Computer Resources Working Group (NCRWG) was still developing the SMP and CRMP (two of the major project management plans). OSF management was taking an active role in the development of these documents. However, the configuration management functions were only addressed at a high level in the SMP and CRMP. The frequency of block releases, the procedures of data handling within the OSF, and the assignment of responsibilities were not sufficiently detailed. A detailed OSF configuration management plan needs to be developed. Since the project and configuration management plans were incomplete (e.g., ILSP) and had not been finalized or approved, there is a risk that the OSF resources may not be adequate for the government to assume software support responsibilities at support management responsibility transfer (SMRT).

3.17.2.2 In addition, the evaluators identified the following issues regarding software support resources planning. First, the planned manning levels of the OSF appeared inadequate to monitor the OSF support contract. Monitoring this contract could become a time-consuming and difficult accountability effort when both government and contract personnel are working on the same project. Second, the personnel and resources needed to provide training for new employees and support-contract personnel after the one-time 14-week software maintenance course were not addressed. Third, automated support tools for software development and configuration management were insufficiently addressed in the planning documents to define the level of resources required. Automated support tools are necessary for configuration management to adequately maintain the NEXRAD configuration baseline. Also, without adequate automated support tools, maintaining and testing the NEXRAD software will be increasingly difficult. Fourth, it was not clear if the OSF, as currently planned, would have the personnel and other resources necessary to resolve the software documentation and source listings problems identified in objective S-16. If the contractor does not correct these deficiencies prior to SMRT, additional OSF personnel and other resources will likely be necessary for the government to maintain the NEXRAD software.

3.17.3 Recommendations.

3.17.3.1 For JSPO:

a. Ensure sufficient automated support tools are available to support configuration management, quality assurance, and software development, test, and distribution. (SR 487)

b. Develop an adequate configuration management plan for the OSF.

3.17.3.2 For JSPO and users: Ensure the ILSP, SMP, and CRMP are coordinated and approved.

3.17.3.3 For OSF:

a. Ensure sufficient resources are available to monitor the OSF software support contractor.

b. Develop an OJT and formal follow-on training program for training new-hires and support-contract personnel after the one-time 14-week contractor-provided training course.

c. Ensure the OSF has the personnel and other resources necessary to maintain the NEXRAD software.

3.18 OBJECTIVE S-18. Assess NEXRAD software usability.

3.18.1 Method. The test team assessed the usability of six NEXRAD software man-machine interfaces through the use of the Software Usability Questionnaire (SUQ) described in AFOTECP 800-2, volume IV, Software Usability Evaluators Guide. The questionnaire addressed the six software usability attributes of confirmability, controllability, workload suitability, descriptiveness, consistency, and simplicity.

3.18.1.1 Through 5 structured interviews, 26 operations personnel independently completed an SUQ for the PUP interface and 20 operators completed an SUQ for the UCP interface. Similarly, during another separate structured interview, five maintenance personnel completed an SUQ for the RDASOT diagnostics, the Concurrent Computer maintenance diagnostics, the Ramtek graphics processor maintenance diagnostics, and the RDA maintenance control console (MCC) interfaces. The personnel were trained on the uses and capabilities of these interfaces before participating in this assessment.

3.18.1.2 An overall score for each interface was obtained by averaging the responses from the questionnaire. The overall average scores were then correlated with operator and maintenance personnel comments. Along with these scores and comments given during the questionnaire, agency specialist comments and documented deficiencies were also used to assess the usability of these interfaces.

3.18.2 Results and Conclusions. The averages of the operators' and maintainers' SUQ responses, by interface, are presented in table III-11. Scores of 3.5 and above indicate generally favorable characteristics, and scores below 3.5 indicate generally unfavorable characteristics.

Table III-11

Operations and Maintenance SUQ Results

Operations		Maintenance			
UCP	PUP	RDASOT	Concurrent	Ramtek	MCC
4.0	4.0	3.3	3.1	3.0	3.0

3.18.2.1 Operations. Operators stated that the menu-driven commands enhanced the PUP and UCP usability. Operators did not have to memorize commands to effectively use the applications terminals. In addition, many product manipulation features were easily invoked using the graphics tablet (e.g., magnify, filter, and recenter). However, the operators identified several UCP and PUP interface deficiencies. First, the UCP applications terminal was unable to accept rapid keyboard inputs. Also, the PUP applications terminal would not execute the return key or function keys when the screen was being updated. As operators became more proficient with keyboard menus and commands, these two problems became more frustrating. Much time was wasted by having to back up and retype the missed keystrokes or repeatedly hit the return key until the system responded. Second, an inadvertent key depressed on the UCP system console, without a return key, eventually led to an RPG failure and halted operations. Third, RCM editing and nonassociated RPG dialup procedures at the PUP were cumbersome. Fourth, the PUP's extended adaptation data were not sufficiently documented and required extensive use of hexadecimal codes. Fifth, editing procedures for the UCP edit screens were inconsistent and cumbersome. Also, different editing procedures existed for similar PUP and UCP edit screens. Finally, operators stated they had difficulty locating information in the PUP and UCP user's manuals since neither manual contained an index.

3.18.2.2 Maintenance. Several usability deficiencies were noted with the four maintenance interfaces. First, for similar functions, the MCC and UCP menu structures and commands were unnecessarily different. The MCC used four letter commands where the UCP used a one-or two-letter series of commands separated by commas. Second, the maintainers were often required to copy important information by hand because printers were not available to support the RDASOT, Ramtek, and Concurrent Computer Corporation diagnostics or the MCC interface. Third, the technical documentation for the MCC interface and the RDASOT and Ramtek diagnostics did not adequately define the proper procedures or explain the meaning and impact of error and status messages. The Ramtek diagnostic procedures were located in a different section of the technical manual than the narrative for the procedures. Also, the RDASOT receiver calibration procedures did not always explain the inputs that were expected from the maintainer.

3.18.3 Recommendations.

3.18.3.1 For JSPO:

a. Ensure adequate PUP and UCP user's manuals are provided with an index. (SR 403)

b. Include adequate menu editing procedures in the PUP and UCP users' manuals. (SRs 544, 543, 226, 333, 040, 175)

c. Provide adequate technical documentation for the Ramtek diagnostics, the RDASOT, and the MCC interface to include meaning and impact of error and status messages. (SRs 129, 384, 355, 048, 066, 117, 151, 479, 388)

d. Eliminate any use of hexadecimal code for character or numeric input. (SRs 415, 438)

e. Eliminate the inconsistencies in the UCP and PUP editing screens. (SRs 029, 250, 309, 015, 175, 161, 039)

f. Provide compatible interfaces for the MCC, UCP, and PUP. (SRs 057, 164, 143)

g. Enable applications terminals to accept keyboard entries during screen updates. (SRs 167, 155)

h. Improve RCM editing procedures. (SRs 358, 333, 336, 428)

i. Provide effective multiple RPG dialup procedures from the PUP. (SRs 395, 393, 394, 415, 515)

3.18.3.2 For JSPO and users: Provide a print capability at the RDA, RPG, and PUP to support the Ramtek, RDASOT, and the Concurrent Computer Corporation diagnostics and the MCC interface. (SRs 181A, 082, 069, 125, 469)

3.19 OVERALL PERFORMANCE:

a. When the overall performance of NEXRAD was considered, the median questionnaire response of all the operators indicated that the system did not meet their requirements as an aid for preparing weather warnings, weather advisories, and routine weather services (see page A-2). Most operators stated that NEXRAD was often not available to support these services because of PUP lockups, system outages, and problems with recovering automatically from power transitions. However, possibly because of their smaller area of weather support responsibilities, DOD median questionnaire responses indicated that the system met their minimum operational needs when the overall NEXRAD performance was considered.

b. When the operators considered the overall responsiveness of the system in a multiple user environment, the median questionnaire response of the operators indicated that the system met their minimum operational needs (see page A-2). However, possibly because of their larger weather support areas, DOC and DOT median questionnaire responses indicated that the system did not meet their minimum operational needs when the overall NEXRAD responsiveness was considered.

3.20 FOLLOW-ON OPERATIONAL TEST AND EVALUATION (FOT&E). To refine estimates of operational effectiveness and suitability, to evaluate changes and modifications made to correct deficiencies, and to evaluate suggested enhancements identified during IOT&E(2), the using agencies should address the following areas during FOT&E.

3.20.1 Operations:

a. FOT&E should be performed in an operational, multiuser environment that includes associated and nonassociated PUPs from all using agencies. To fully evaluate the maximum processing load, the agencies should conduct FOT&E during a significant weather season. During FOT&E, NEXRAD should be the only weather radar that operators use to meet information dissemination requirements.

b. The system evaluated during FOT&E should include limited and/or full-scale production phase capabilities. The new capabilities that should be tested during FOT&E include the hydrology algorithms, full RPGOP communications speed, and the limited and full-scale production phase algorithms.

3.20.2 Logistics. Organizational-level maintenance should be performed on a production-model NEXRAD using validated and verified technical manuals, the integrated logistics support infrastructure, and representative training.

3.20.3 Software. To test government software support resources during FOT&E, the OSF should generate and test a new software version release to include adding, deleting, and changing functionality within the RDA, RPG, and PUP. This should be accomplished well in advance of the SMRT.

SECTION IV - SERVICE REPORTS

4.0 SERVICE REPORT STATUS. The test team identified deficiencies and enhancements. Service reports (SRs) were written and provided to the JSPO for disposition in accordance with Air Force TO 00-35D-54. The status of SRs documented or revalidated during IOT&E(2) is outlined in table IV-1.

Table IV-1

Status of Service Reports
(As of 13 Aug 1989)

Category	Identified During IOT&E(2)	Revalidated During IOT&E(2)	Total Open
Category I	9	3	12
Category II			
Deficiencies	477	84	561
Enhancements	59	23	82
Total	545	110	655

DEFINITIONS:

a. Category I. A deficiency that required immediate corrective action because:

(1) The condition may cause death, severe injury, severe occupational illness, or major system damage or loss.

(2) The condition causes unacceptable delays in accomplishing testing or prevents successful mission accomplishment (due to severity and frequency of the deficiency) and would critically impact the operational capability of the system.

b. Category II:

(1) Deficiency. A condition which prevents successful mission accomplishment (system does not meet minimum operational requirements, but does not justify immediate corrective action in accordance with Cat I) or degrades a system's operational effectiveness and/or suitability.

(2) Enhancement. A condition that would complement but is not absolutely required for successful mission accomplishment. The recommended condition, if incorporated, will improve a system's operational effectiveness and/or operational suitability. Appendix C identifies these SRs by preceding the SR number with the letter "e."

Table IV-1 (continued)

c. Identified During IOT&E(2). SRs that the test team discovered and validated during IOT&E(2). Table IV-2, table IV-3, and appendices B and C identify these SRs by having a three-digit SR number.

d. Revalidated During IOT&E(2). SRs that the test team discovered during IOT&E(1A) and IOT&E(1B) and revalidated during IOT&E(2). Table IV-2, table IV-3, and appendices B and C identify these SRs by having a three-digit SR number followed by the letter "A" or "B."

4.1 PRIORITIZED SRs. The test team prioritized all identified and revalidated SRs using the Deficiency and Enhancement Analysis Ranking Technique method. Table IV-2 contains the prioritized list of the Category I SRs, and table IV-3 contains a prioritized list of the top 40 Category II SRs that impacted the test objectives. All 655 SRs are included in appendices B and C. The complete prioritized list of 12 Category I SRs is in appendix B, and the 643 Category II SRs are in appendix C.

Table IV-2

List of Prioritized Category I Service Reports
Opened During IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
1	168	Safety - Unsafe Power Down Procedures for Component Replacement
2	012	Safety - Hazards Associated with the Use of Radome Davit Assembly
3	010	Safety - Hazards with Large Radome Hatch Cover
4	264A	Personnel Hazard Due to Potentially Unprotected Hatch Opening
5	262A	Personnel Safety Hazard When Opening the RDA or RPG Tower Room Floor Hatch
6	190	Safety - "Eye Wash" Required in RDA Generator Shelter
7	189	Safety - Hazard Associated With Exhaust Fan in Generator Shelter
8	011	Safety - Inadequate Safety Railing Around Large Radome Hatch Opening
9	009	Safety - Hazard Associated with Entry/Exit Radome Hatch Opening
10	076	Safety - Inadequate/Inappropriate Fire Suppression Systems at IOT&E(2) Principal User Processor (PUP) Sites
11	049	Safety - Generator Shelter Entrance Hazard
12	061A	Unusable Handrail in Tower

Table IV-3

List of Top 40 Prioritized Category II Service Reports
Opened During IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
1	098B	Potential Transmitter Reliability Problem
2	531	Too Many System Status False Alarms
3	317	Transfer Between Commercial and Backup Power Frequently Forces The RPG into an Inoperable Condition
4	206	Spare Transmitter Line Replaceable Units' (LRUs) Configuration Not Compatible with System Under Test
5	083	Frequent Ramtek Graphics Processor Lock-Ups
6	072B	Undefined RDA Alarms
7	006B	Erroneous Failure Messages on System Status Menu
8	087B	Failure of Automatic RPG Restart
9	014	Chapter 5 Preliminary Technical Manual (PTM) Inadequate
10	265A	Preliminary Technical Manual Deficiencies
11	129	Inadequate Documentation of System Status Messages at the RDA, UCP, and PUP Applications Terminals
12	530	Deletion of and Difficulty in Viewing System Status Messages at UCP and PUP
13	010A	Loss of Radar Data
14	396	New Correction Factors for Suncheck Measurement Subtest 1 (Align Pedestal) Will Not Update Correctly
15	168A	Audio Alarms at the UCP
16	437	Numerous PUP Deficiencies Apparently Related to Graphic Display of Status Messages
17	219	Degraded Operational Utility of Base Velocity Products Due to Range Folding
18	002B	Transmitter Faults Causing Wedges of Missing Data
19	440	Numerous Discrepancies in "RDA Calibration" Procedures
20	164A	Calibration of NEXRAD Unit
21	400	Corrupted Links In Database File
22	112A	Failed Power Transistor
23	138A	Undefined PUP System Status Messages
24	166	System Does Not Stay On Auxiliary Power When Switchover is Commanded From the UCP or the RDA Maintenance Terminal
25	017	Orderly Shutdown of RDA at RDA Shelter Not Possible
26	391	Safety - Inadequate Warning/Caution Signs Throughout NEXRAD
27	227	NEXRAD Transmitter Field Maintenance Manual (NWS EHB 6-514) Inadequate
28	500	Apparent Velocity Dealiasing Errors
29	196	Recenter/Magnify Product Function Unreliable
30	328	NEXRAD Commercial Manuals of The Preliminary Technical Manual (PTM) Inadequate
31	384	Inadequate Procedures in RDASOT User's Guide for Generation of Clutter Map
32	463	Safety - Personnel Hazard Associated With the Fixed Ladder Attached to the Antenna
33	027B	Need for Audio Alarm for Free Text Message (FTM)
34	138	Chapters 1-4 and 6 of Preliminary Technical Manual (PTM) Inadequate

Table IV-3 (continued)

List of Top 40 Prioritized Category II Service Reports
Opened During IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
35	286	Safety - Inadequate Warnings Located in Chapter 5, Preliminary Technical Manual (PTM)
36	009A	Need for Alert of System Failure
37	420	RDA Transmitter Beam Voltage Calibration Data Not Available
38	207	Safety - Inappropriate Method to Bypass Interlock Switch S4 in Transmitter Cabinet
39	087	Excessive Acoustic Noise Associated With PUP Cabinets
40	133	Safety - Noncompliant Grounding and Bonding

SECTION V - SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

5.0 SUMMARY:

a. A matrix of test results for those objectives for which operational requirements existed is included in appendix A.

b. The definitions of the terms "evaluate," "assess," "met requirement," and "did not meet requirement" are contained in the glossary at appendix E.

5.1 OBJECTIVE E-1. Evaluate NEXRAD as an effective aid in preparing accurate and timely weather warnings. (Reference paragraph 3.1)

5.1.1 Conclusion. NEXRAD met the users' requirement for weather warning support. Operators stated that NEXRAD met their minimum operational requirements primarily because of the high resolution and accuracy of the NEXRAD reflectivity-based products. The capability to magnify and time-lapse storms in high color resolution, the use of background maps, and the use of the reflectivity-based VIL products were particularly effective. However, during widespread convective activity, velocity-based products were often severely degraded by large areas of range-folded and incorrectly dealiased data. Additionally, the incorrectly dealiased velocity fields and the current state of the mesocyclone detection and hail algorithms resulted in numerous false severe weather indications. Further, the DOC operators could not locate severe storms with respect to Oklahoma cities and towns with the contractor-provided background maps. To overcome this deficiency, DOC operators developed a city background map of sufficient detail to prepare accurate weather warnings.

5.1.2 Recommendations. For JSPO:

a. Eliminate the impact of range-folded data on the velocity-based products (SR 219).

b. Provide an effective velocity dealiasing algorithm (SRs 500, 062B, 441, 507).

c. Provide reliable hail and mesocyclone detection algorithm outputs (SRs 208, 380, 228A).

d. Provide complete background maps with adequate detail (SRs 050, 349, 238A, 281, 122, 433).

5.2 OBJECTIVE E-2. Evaluate NEXRAD's impact on operator workload. (Reference paragraph 3.2)

5.2.1 Conclusion. NEXRAD met the users' requirement for operator workload when the NEXRAD PUP alone was used to perform existing agency weather support activities. The operator workload when the UCP and PUP were used together did not meet the users' requirement. DOC and DOD operators found that using the NEXRAD PUP alone to meet existing agency requirements resulted in a slight increase in operator workload. However, DOT operators stated that manually acquiring and examining products from multiple NEXRADs would produce a significant increase in their workload. Operators stated that using the UCP and the PUP together produced a significant increase in operator workload. Operators noted that this was primarily the result of required system responsibilities to support the multiple-user radar configuration. These UCP duties were sometimes delayed or not performed because of other mission requirements. Because of limitations associated with the FTM functionality, operators at the UCP site were frequently interrupted from mission duties to respond to telephone calls from the other two associated PUP sites or to initiate calls to them.

5.2.2 Recommendations. For JSPO:

a. Correct deficiencies with the UCP user interface (SRs 530, 168A, 009A, 167, 402, 173, 082B, 337, 164, 069, 177, 175, 174).

b. Correct deficiencies associated with the FTM functionality (SRs 027B, 178, 446, 447, 445).

c. Correct deficiencies associated with the dialup interface (SRs 395, 394, 515).

5.3. OBJECTIVE E-3. Assess whether current position qualifications for agency personnel are adequate to effectively use NEXRAD. (Reference paragraph 3.3)

5.3.1 Conclusions. There was a consensus among operators, supervisors, and specialists of all three agencies that current agency position qualifications were adequate for NEXRAD. However, they stated that without proper training, personnel having these qualifications will not be able to use NEXRAD PUPs and UCPs effectively for the duties of their assigned positions (e.g., meteorologist, weather officer, weather forecaster, or weather observer).

5.3.2 Recommendation. For JSPO and users: Ensure effective and appropriate NEXRAD operations training is provided to agency personnel (also see objective ES-9, Training).

5.4 OBJECTIVE E-4. Evaluate NEXRAD capability to provide required operational support to multiple users. (Reference paragraph 3.4)

5.4.1 Conclusions. NEXRAD's capability to provide required operational support to multiple users met the users' requirement. For associated users, operators from the three test sites stated that, in general, NEXRAD provided RPS products in a timely manner including times when the unit was operated in a mode simulating a 19-user configuration. Because of their reliance on cross-section and WER products during the test and dialup feature limitations, the DOT operators stated that the responsiveness of the NEXRAD system did not meet their operational requirements. For nonassociated users, operators and specialists identified several deficiencies. First, dialup procedures for acquiring products from multiple RPGs were cumbersome and time-consuming. This deficiency will particularly impact agency centers requiring routine access to multiple RPGs. Second, the RPG telephone number directory could only contain a maximum of 12 digits for each RPG, making long-distance dialing through most facility switchboards impossible. Third, background maps from nonassociated RPGs were automatically deleted from the PUP product data base after only 6 hours. In addition, the functionality to store and retrieve maps using optical disk media was inoperable. Therefore, operators had to repeatedly request maps over dialup lines. Site supervisors found that the URC was an effective forum for the principal user agencies to coordinate the use of NEXRAD. Test team specialists noted that URC-developed agreements need to be quickly incorporated into each station's operating procedures. Further, the specialists identified the need for strong agency support and guidance regarding multiple user support functions and how NEXRAD-related responsibilities relate to current duty priorities.

5.4.2 Recommendations. For JSPO:

a. Provide an effective capability to acquire products from multiple RPGs (SRs 395, 393, 394, 515).

b. Provide the capability to retain nonassociated background maps in a separate PUP storage area (SR 410).

c. Provide the capability to store and retrieve nonassociated RPG background maps (SR 338, 326).

d. Investigate the adequacy of NEXRAD to support receipt of products during periods of widespread precipitation (SR 502).

e. Ensure cross-section and WER products are received in a timely manner.

5.4.2.2 For users:

a. Develop procedures for responsive implementation of URC-coordinated changes at individual associated site locations.

b. Provide guidance regarding multiple-user support functions and how NEXRAD-related responsibilities relate to current duty priorities.

5.5 OBJECTIVE E-5. Evaluate NEXRAD as an effective aid in preparing accurate and timely weather advisories. (Reference paragraph 3.5)

5.5.1 Conclusions. NEXRAD met the users' requirement for weather advisories. Operators reported that the resolution of the reflectivity products allowed them to accurately identify the location of significant weather with respect to specific advisory and aircraft route locations. The sensitivity of the reflectivity products allowed operators to identify many features such as gust fronts, thunderstorm outflow boundaries, and fine lines. Identification of these features, combined with the use of VAD wind profiles and base velocity products to identify inversions and low-level jet streams, enabled operators to provide timely terminal wind advisories and low-level wind shear advisories. However, operators did not find useful information in the layered-turbulence products. Previously identified deficiencies with velocity dealiasing and range-folded velocity data often prevented operators from determining the strength of winds associated with convective-related features identified in the reflectivity data (e.g., gust fronts). The test team noted two limitations associated with the use of the automated alert feature that reduced this feature's effectiveness. First, the current state of the storm-series algorithms appeared to produce frequent false indications of significant weather (e.g., hail and mesocyclonic shear). Second, specialists observed that because of inadequate applications training operators did not always know how to apply alert thresholds and alert areas to match existing meteorological conditions.

5.5.2 Recommendations.

5.5.2.1 For JSPO:

a. Provide effective layered turbulence products (SRs 160, 421).

b. Eliminate the impact of range-folded data on the velocity-based products (SR 219).

c. Provide an effective velocity dealiasing algorithm (SRs 500, 062B, 441).

d. Provide effective hail and mesocyclone algorithms (SRs 380, 228A).

5.5.2.2 For JSPO and users: Provide adequate training on the appropriate application of the automated alert feature for each users' weather support requirements (SRs 015, 247, 455).

5.6 OBJECTIVE E-6. Evaluate NEXRAD as an effective aid in providing routine weather services. (Reference paragraph 3.6)

5.6.1 Conclusions. NEXRAD met the users' minimum requirement as an effective aid in short-range forecasts, surface observations, briefings, and aircraft traffic management. To support routine weather services, the high resolution and sensitivity of NEXRAD aided in the identification of fronts, wind shift lines, precipitation areas, and dry lines. Clear-air mode operation was particularly effective in identifying small-scale features. VAD and base velocity products, when not contaminated by large areas of range-folded and incorrectly dealiased data, aided in the preparation of surface forecasts and in diagnosing vertical wind field changes. DOD observers stated they could effectively use NEXRAD products and manipulation features to determine storm location and movement for inclusion in surface weather observation remarks. DOD forecasters and observers stated they were able to prepare a reflectivity-only radar observation more accurately and typically in less than half the time with NEXRAD than is presently required for the FPS-77 weather radar. DOD forecasters stated the ability to time-lapse color radar information and remote that information to the briefing counter was particularly valuable. DOC operators were able to prepare civil defense briefings primarily because of detailed reflectivity data placement on the country and operator-generated city background maps. DOT and DOD operators noted the effectiveness of the reflectivity and VAD products aided in displaying the meteorological conditions for planned briefings. However, the DOT operators stated that on-demand briefing effectiveness was degraded because one-time and dialup product requests were not responsive (see objective E-4). Additionally, the automatic scan mode deselection feature often forced an operationally undesirable switch to the precipitation mode because of AP. All DOC operators stated that the new requirement of editing the RCM produced a significant increase in their workload. Operators spent significant time verifying and removing residual clutter, AP, and false indications of mesocyclones and hail.

5.6.2 Recommendations.

5.6.2.1 For JSPO:

a. Eliminate the impact of range-folded data on the velocity-based products (SR 219).

b. Provide an effective velocity dealiasing algorithm (SRs 500, 062B, 441).

c. Reduce the impact of the RCM on operator workload (SRs 484, 258A, 307, 358, 411, 333, 427, 336, 385).

d. Ensure one-time products are received in a timely manner for on-demand briefings (SR 166A).

e. Provide an effective capability to acquire products from multiple RPGs (SRs 395, 393, 394, 515).

5.6.2.2 For JSPO and users: Provide the UCP operator the capability to override the automatic scan mode deselect feature and 1-hour timeout when operationally required. Ensure the FMH-11 allows the UCP operator to use this capability. (SR 250A).

5.7 OBJECTIVE E-7. Assess NEXRAD as an effective aid to meeting agency mission requirements when changing to, operating on, and recovering from backup power. (Reference paragraph 3.7)

5.7.1 Conclusions. NEXRAD was not an effective aid in meeting agency mission requirements when changing to and recovering from backup power. During IOT&E(2) Part B, the system failed 17 times (RDA 4 times, RPG 12 times, and PUP 1 time) because of power transitions--whether unscheduled or operator-initiated. In these cases, a maintenance action and a manual restart was required. Outage times resulting from power transfers ranged from 11 minutes to 8 hours 54 minutes. These failures resulted in an increase in workload, an increase in maintenance interventions, and the loss of critical radar data. Operators stated that the loss of critical radar data during significant weather situations resulted in a significant decrease in the effectiveness of NEXRAD as an aid in providing weather warning and advisory support. Conversely, operators observed that the three operational PUPs recovered automatically after power transitions except for one event at Tinker AFB BWS. Operators did not observe any change in system performance or operator workload when NEXRAD was operating on backup power.

5.7.2 Recommendation. For JSPO: Ensure the RDA and RPG effectively and automatically return to an operational state following power transitions (SRs 317, 087B).

5.8 OBJECTIVE E-8. Assess NEXRAD electromagnetic compatibility (EMC). (Reference paragraph 3.8)

5.8.1 Conclusions. The test team maintenance technicians noted one apparent EMC problem--a wavy presentation on the RDA applications terminal throughout IOT&E(2). Operators did not observe any EMC incidents associated with the operation of NEXRAD equipment, nor was there any observable effect on any nearby equipment.

5.8.2 Recommendation. For JSPO: Investigate and resolve cause of the RDA applications terminal having a wavy presentation (SRs 051A, 131).

5.9 OBJECTIVE ES-9. Assess the adequacy of the planned NEXRAD training to provide the skills required to effectively use and maintain NEXRAD. (Reference paragraph 3.9)

5.9.1 Conclusions. The training assessment was separated into three areas: operations, maintenance, and software.

5.9.1.1 Operations. Test team training specialists stated that the planned Cadre and Interim Operations courses were deficient. The Cadre course lacked sufficient detail and would not adequately prepare agency instructors to teach NEXRAD operations. In addition, they stated the Interim Operations Course would not support the training of students to the agency-required skill level. DOC training specialists stated that DOC/DOT planned CBT was an area of high risk. Training specialists identified deficiencies associated with the planned CBT, and current DOC plans did not address required on-site training. A comprehensive DOD NEXRAD operations training plan had not been prepared. Formal DOD course requirements had not been finalized; consequently, manpower requirements to support training had not been adequately defined. The PUP training mode and NEXRAD archive functionality demonstrated a potential to support hands-on operations training. However, test team-identified deficiencies with these features limited their usefulness during IOT&E(2).

5.9.1.2 Maintenance. Without significant changes, the planned NEXRAD maintenance training will not provide the necessary training for an agency technician to acquire the needed skills to effectively maintain a NEXRAD system in accordance with the maintenance concept. The test team identified several deficiencies with planned maintenance training. In addition, deficiencies were identified in the 7-week IOT&E(2) maintenance course. The PTM, which was used as the primary course reference, was ineffective as a training tool (see objective S-15). These training deficiencies directly contributed to the excessive troubleshooting and repair times experienced during IOT&E(2). Unless these training problems are resolved before the start of cadre training, the goals of the NEXRAD maintenance concept will not be achieved and operational availability will probably be adversely affected.

5.9.1.3 Software. The planned NEXRAD training will probably not provide the skills necessary to effectively maintain the NEXRAD software. The structure of the course did not follow an organized, logical plan. The course provided an adequate knowledge of the organization and operation of NEXRAD software but not the detailed skills and procedures needed for software maintenance. There was insufficient hands-on laboratory time to gain experience with the NEXRAD software maintenance procedures. A review of the proposed 14-week course showed that the same deficiencies identified in the 7-week IOT&E(2) course will probably be repeated. In addition, no follow-on, OJT, or additional formal training was planned. Unless the deficiencies identified above are corrected, software maintainers will likely require an extensive on-the-job trial-and-error process to acquire the skills needed to maintain the NEXRAD software.

5.9.2 Recommendations.

5.9.2.1 For JSPO:

a. Operations:

(1) Ensure adequacy of Personnel Requirements, Training, and Training Equipment Plan (CDRL 218) in meeting agency operations training requirements.

(2) Correct deficiencies associated with the PUP training mode (SRs 059, 162, 460, 579, 505).

(3) Correct deficiencies associated with NEXRAD archive functionality to help support operator training. (SRs 120, 325, 351, 194, 338).

b. Maintenance. Ensure the technical manuals are sufficiently upgraded and adequate course material is developed to meet both the theory and hands-on training requirements of the cadre training course and the first increment of field maintainers. (SRs 014, 265A, 129, 440, 138A, 227, 328, 384, 138, 286, 420, 544, 251).

c. Software:

(1) Ensure the contractor's 14-week software maintenance course is restructured to follow a logical, organized plan.

(2) Ensure the focus and level of detail of the contractor's 14-week software maintenance course provide the students instruction in the proper use of the software tools necessary to maintain the NEXRAD software.

(3) Ensure the contractor's 14-week software maintenance course provides adequate hands-on laboratory time.

5.9.2.2 For JSPO and users - Maintenance:

a. Ensure the contractor's maintenance instructors are sufficiently knowledgeable of NEXRAD to teach both theory and hands-on maintenance for all functional areas. Until Unisys demonstrates the ability to provide an adequate training course, make maximum use of subcontractor equipment training experts (e.g., Concurrent Computer Corporation training instructors).

b. Ensure detailed lesson plans are developed well in advance of cadre training. Inspect these plans to determine adequacy of course content and length.

c. Ensure the course contains an introduction to all areas of instruction that have not been previously taught to current 5-level technicians (e.g., fiber optics, computer architecture, etc.).

5.9.2.3 For DOC and DOT - Operations:

a. Evaluate the potential of supplementing CBT instruction at the training site with hands-on use of PUPs and an RPG using Archive II playback capability.

b. Prepare training materials to address on-site, follow-on NEXRAD training.

5.9.2.4 For DOD - Operations:

a. Ensure a comprehensive, coordinated training plan is developed.

b. Ensure manpower requirements to meet training needs are adequately defined and personnel are available in time to prepare for cadre training.

5.9.2.5 For OSF:

a. Ensure adequate OJT materials and a follow-on software maintenance course are developed for training OSF software personnel.

b. Ensure adequate system time is provided for operations, maintenance, and software course development and for hands-on instruction during laboratory sessions.

5.10 OBJECTIVE ES-10. Assess impacts of any safety hazards associated with NEXRAD. (Reference paragraph 3.10)

5.10.1 Conclusions. The test team identified and documented 56 safety deficiencies during IOT&E(2). Nine of the deficiencies were hazards that had the potential to cause death, severe injury, and/or major system damage (Category I). Of the remaining 47 safety deficiencies (Category II), 16 had the potential to cause minor injury to personnel or minor damage to the equipment, while the other 9 had the potential to cause minor equipment damage only. All identified safety deficiencies were documented in service reports.

5.10.2 Recommendations. For JSPO:

a. Ensure the contractor corrects all identified Category I safety deficiencies. (SRs 168, 012, 010, 264A, 262A, 190, 189, 011, 009, 076, 049, 061A)

b. Ensure the contractor corrects all identified Category II safety deficiencies. (SRs 391, 463, 286, 207, 133, 404, 169, 357, 533, 032, 098, 113)

c. Ensure safety warnings and safe equipment power-down/power-up instructions are incorporated into all applicable maintenance procedures in the technical data. (SRs 168, 286, 285)

5.11 OBJECTIVE ES-11. Assess factors impacting the interoperability of NEXRAD with existing and planned systems. (Reference paragraph 3.11)

5.11.1 Conclusions. The test team found there was inadequate information in the interface control documents to interface planned systems with PUES communications ports using the Redbook data formats. Information in the CIUG and ICDs was not logically ordered, and topics were scattered over several documents. Although, there appeared to be sufficient information to interface systems with the "Other Users" ports on NEXRAD, test team specialists identified deficiencies that made it difficult and time-consuming to find and organize the required information.

5.11.2 Recommendations.

5.11.2.1 For JSPO:

a. Provide a stand-alone interface document for each NEXRAD interface. (SRs 407, 526, 302)

b. Clearly document deviations from accepted standards and protocols (SRs 261, 486).

5.11.2.2 For users: Investigate if the identified concerns associated with the PUES port will adversely impact its intended use.

5.12 OBJECTIVE S-12. Assess NEXRAD reliability. (Reference paragraph 3.12)

5.12.1 Conclusions. The demonstrated MTBM (total corrective) for the NEXRAD system was 25.3 hours. The demonstrated MTBM (total corrective) for the RDA, RPG, and PUP was 53.1 hours, 78.6 hours, and 125.6 hours, respectively. Reliability problems were identified with the preproduction transmitter, the RPG following power transitions, the graphics processors, and the optical disk drive unit. The decreased reliability and the similar maintainability between current agency weather radars and NEXRAD indicated that NEXRAD will increase the workload for technicians at maintenance locations responsible for an entire NEXRAD system. For PUP only sites, NEXRAD may have little or no impact on maintenance workload.

5.12.2 Recommendations. For JSPO:

a. Assess transmitter reliability and take appropriate action to correct recurring transmitter problems. (SRs 098B, 002B, 112A, 149)

b. Correct problems associated with the RPG failing to recover automatically after power transfers. (SRs 317, 087B)

c. Determine the underlying causes of Ramtek graphics problems and take appropriate action to eliminate recurrence. (SRs 083, 301, 418)

d. Correct problems associated with the optical disk drive unit and archive functionality. (SRs 368, 061, 332, 051)

e. For all other failures, determine the failure sources and take corrective action.

5.13 OBJECTIVE S-13. Evaluate NEXRAD maintainability. (Reference paragraph 3.13)

5.13.1 Conclusions. For LRU malfunctions, the demonstrated system MTTR of 9.0 hours did not meet user's requirement of 0.5 hour. PFI isolated 50 percent of LRU malfunctions to a single LRU, which did not meet the user's requirement of 80 percent. The PFI isolated LRU malfunctions to three or fewer LRUs 57.1 percent of the time, which did not meet the user's requirement of 95 percent. The three primary deficiencies that contributed to the system's MTTR were training (see objective 9), the PTM (see objective 15), and PFI. During IOT&E(2), PTM fault isolation flowcharts, on-line diagnostics, and off-line diagnostics were inadequate for isolating faults in the NEXRAD system within the maintenance concept. The fault isolation flowcharts had limited usefulness as the primary fault isolation tool. The flowcharts were incomplete and ambiguous and they contained numerous errors. The on-line diagnostic's use of BIT and self-diagnostic logic seemed to be sufficiently integrated within the system; however, several deficiencies limited its benefit. Off-line diagnostics were not sufficient to isolate faults. Adequately detailed documentation for each off-line diagnostics was not available. The system MTTR was greatly impacted by the RDA MTTR of 18.0 hours. The on-line system status monitoring system generated status alarms/messages so frequently (approximately 45 per hour) that the PUP and UCP operators often ignored them, even though some indicated "maintenance mandatory."

5.13.2 Recommendations. For JSPO:

a. Ensure the technical data are adequate to maintain the system. (SRs 014, 265A, 129, 440, 138A. 227, 328, 384, 138, 286, 420, 544, 251, 543, 403, 239, 169A, 285, 416, 439, 077)

b. Resolve all training issues impacting maintainability (see objective ES-9).

c. Ensure on-line fault monitoring is improved by reducing the frequency of system status alarms/messages and by eliminating unconfirmed fault indications. (SRs 531, 072B, 006B, 129, 530, 168A, 437, 138A, 009A, 139A, 104A, 439)

d. Ensure the system on-line BIT and self-diagnostics are improved to consistently and accurately isolate faults within specific areas/subsystems. (SRs 072B, 439, 212, 248, 300, 057, 541, 255A, 386, 467, 213)

e. Ensure all off-line diagnostic tests are improved so that LRU malfunctions can be isolated within the criteria specified by the maintenance concept. (SRs 251, 169A, 264, 018, 008, 378, 170, 048, 094, 064, 066, 117, 245, 151, 082, 141, 368, 065, 471, 319, 470, 469)

f. Provide sufficient storage and workspace for maintenance in the RDA and generator shelters. (SRs 187, 047B, 096)

g. Ensure all equipment/LRUs are correctly labeled and cable routing and terminations are designed for ease-of-maintenance. (SRs 098, 159, 055, 208A, 124, 125A, 268, 036, 132, 262, 312, 314, 038, 034B, 292, 347, 144, 472, 134, 232, 070B, 148, 099, 045, 030, 156, 145, 105, 054, 116, 171, 114)

h. Provide secondary fault isolation procedures to augment and back up the PFI. (SR 169A)

5.14 OBJECTIVE S-14. Evaluate NEXRAD availability. (Reference paragraph 3.14)

5.14.1 Conclusions. The NEXRAD full system operational availability of 86.3 percent did not meet the user's requirement of 90 percent. The NEXRAD degraded system operational availability of 88.2 percent did not meet the user's requirement of 96 percent. The RDA availability had the greatest impact on system availability. The largest detractor from the RDA availability was the preproduction transmitter reliability and maintainability problem (11 transmitter failures with a 10.4 hour MTTR). Although the RPG failures associated with power transitions did not have a significant impact on overall system availability, the timing of these events critically degraded operational effectiveness. When the operators considered total system effectiveness, including the impact of availability for supporting mission requirements, they stated that the system did not meet their minimum operational requirements.

5.14.2 Recommendations.

5.14.2.1 For JSPO:

a. Ensure RDA reliability and maintainability problems, particularly with the transmitter, are resolved. (SRs 098B, 206, 002B, 112A, 420, 207, 354, 096, 026, 149, 036, 078, 033B, 267, 483, 353, 185, 327, 073, 095, 118)

b. Ensure RPG power transfer problems are resolved. (SRs 317, 087B, 166)

c. Ensure overall system maintainability problems are resolved (see objectives S-12 and S-13).

5.14.2.2 For JSPO and users: Ensure sparing level is adequate to meet availability requirements.

5.15 OBJECTIVE S-15. Assess the adequacy of logistics support. (Reference paragraph 3.15)

5.15.1 Conclusions. The PTM and the JSPO list of required support equipment did not agree. The test team identified 20 items of support equipment required by the PTM for maintenance activities which were not on the JSPO list. These deficiencies limited the maintainers' ability to perform or complete scheduled and unscheduled maintenance actions. The JSPO-provided complement of on-site spares was not adequate to maintain the system in accordance with the maintenance concept. Therefore, the provisioning process must identify a sparing level that is better aligned to the agencies' requirements than the contractor-proposed, JSPO-approved package of spares that was provided for IOT&E(2). Of the 56 LRU replacements required during IOT&E(2), 16 spares (28.6 percent) were on site and the remaining 40 spares (71.4 percent) had to be ordered. Also, upon receipt, 11 of the 40 contractor-provided spares were incompatible with the unit being tested in IOT&E(2). The majority of the incompatible LRUs were for the RDA. The unanimous opinion of the maintenance technicians was that the PTM was inadequate for training and for maintaining the NEXRAD system. The PTM was incomplete and ambiguous and contained numerous errors. As a result, maintenance technicians stated that the PTM was inadequate for 83 out of 159 maintenance actions documented on maintenance incident questionnaires during IOT&E(2). Additionally, of the 72 PMIs scheduled during Part B, 42 had documented technical data deficiencies; 17 of these 42 could not be completed. The planned cadre training will likely be ineffective if the technical manuals do not have major upgrade prior to its start. Until the technical manuals are complete and the ambiguities and errors are removed, the NEXRAD system will probably not be maintainable in accordance with the NEXRAD maintenance concept and operational effectiveness will likely be adversely impacted.

5.15.2. Recommendations.

5.15.2.1 For JSPO and users:

a. Ensure the technical data identify all support equipment required to complete organizational-level maintenance. (SRs 202, 078, 023, 483, 209, 192, 536, 107, 236)

b. Ensure sparing level is adequate to meet availability requirements.

5.15.2.2 For JSPO:

a. Ensure spares provided by depot are compatible with the fielded unit (e.g., limited production spares for limited production equipment). (SRs 206, 480, 099)

b. Ensure the technical data are significantly upgraded, validated, and verified well before the cadre training to meet both the theory and hands-on training requirements. (SRs 014, 265A, 129, 440, 138A, 227, 328, 384, 138, 286, 420, 544, 251)

c. Ensure all alignments and PMI procedures that are required to maintain the NEXRAD system are correct and included in the technical data. (SRs 440, 164A, 384, 420, 169, 354, 285, 197, 355, 482, 005, 112, 412, 535, 312, 353)

d. Ensure the NEXRAD system technical data are adequate for a 5-level maintenance technician to maintain NEXRAD in accordance with the maintenance concept.

e. Provide secondary fault isolation procedures to augment and back up the PFI. (SR 169A)

5.16 OBJECTIVE S-16. Evaluate NEXRAD software maintainability. (Reference paragraph 3.16)

5.16.1 Conclusions. Overall, the documentation and source listing evaluation for the four CPCIs evaluated met the users' requirement of 3.5.

5.16.1.1 The evaluators identified significant problems in the documentation. The characteristics of testability and traceability did not meet the requirement of 3.5 for any of the four CPCIs. The characteristic of descriptiveness did not meet the requirements of 3.5 for two of the four CPCIs evaluated. Expandability did not meet the requirement for CPCI-01. The primary reasons why these documentation characteristics average below 3.5 are listed below. First, the C5s were inadequate for each of the CPCIs evaluated. It was difficult, time-consuming, and sometimes impossible to find module descriptions, data flow descriptions, and calling sequences. Second, the data dictionaries were inadequate for each CPCI evaluated. Third, the VDD for each CPCI did not contain adequate descriptions. The files needed to compile and link a CPCI were not fully specified, and other CPCIs associated with or used by a CPCI were inadequately specified.

5.16.1.2 The source listings were determined to have simple, expandable, and modular characteristics. These coding characteristics enhanced the maintainability of the software. However, the characteristic of traceability did not meet the requirements for any of the four CPCIs evaluated. The major deficiency that adversely impacted traceability was the inadequate preface block in each module's source listing. Of the 179 modules evaluated, 165 modules had errors, inconsistencies, or incomplete information.

5.16.1.3 Although the documentation and source listings met the users' requirements as evaluated using standard questionnaires, additional personnel and other resources will likely be necessary to maintain and update the NEXRAD software unless the above identified deficiencies are corrected.

5.16.2 Recommendations. For JSPO:

a. Ensure the contractor reviews and corrects, for all modules, the deficiencies associated with the preface blocks and imbedded comments of the source listings. (SRs 352, 496, 497, 401)

b. Correct the deficiencies with the software C5 documentation. (SRs 335, 493, 290, 289, 492, 374, 491, 362, 342, 498, 334, 316)

c. Correct the deficiencies with the data dictionaries. (SR 323)

d. Ensure each version description document adequately describes each CPCI. (SRs 494, 341)

5.17 OBJECTIVE S-17. Assess the adequacy of planned and existing NEXRAD software support resources (SSR). (Reference paragraph 3.17)

5.17.1 Conclusions. There is a risk that the current and planned software support resources may not be adequate for the government to assume software support responsibilities at the appropriate time. The OSF was hiring personnel with adequate experience and skills and was addressing facility space shortfalls. However, detailed project and configuration management plans were incomplete and had not yet been finalized or approved. The ILSP, SMP, and the CRMP were not completed or signed. A detailed OSF configuration management plan needs to be developed. The planned manning levels of the OSF appeared to be inadequate to perform contract monitoring functions or to train new-hires and support-contract personnel. Automated support tools for software development and configuration management were insufficiently addressed in the planning documents to define the level of resources required.

5.17.2 Recommendations.

5.17.2.1 For JSPO:

a. Ensure sufficient automated support tools are available to support configuration management, quality assurance, and software development, test, and distribution. (SR 487)

b. Develop an adequate configuration management plan for the OSF.

5.17.2.2 For JSPO and users: Ensure the ILSP, SMP, and CRMP are coordinated and approved.

5.17.2.3 For OSF:

a. Ensure sufficient resources are available to monitor the OSF software support contractor.

b. Develop an OJT and formal follow-on training program for training new-hires and support-contract personnel after the one-time, 14-week contractor-provided training course.

c. Ensure the OSF has the personnel and other resources necessary to maintain the NEXRAD software.

5.18 OBJECTIVE S-18. Assess NEXRAD software usability. (Reference paragraph 3.18)

5.18.1 Conclusions.

5.18.1.1 The averages for the operations SUQ indicated generally favorable usability characteristics for the PUP and UCP software interfaces. Operators stated that the menu-driven commands enhanced the PUP and UCP usability. Operators did not have to memorize commands to effectively use the applications terminals. In addition, many product manipulation features were easily invoked using the graphics tablet (e.g., magnify, filter, and recenter). However, several deficiencies were noted. The UCP applications terminal was unable to accept rapid keyboard inputs. The PUP application terminal would not execute the return key or function keys when the screen was being updated. RCM editing and nonassociated RPG dialup procedures at the PUP were cumbersome. The PUP's extended adaptation data were not sufficiently documented and required extensive use of hexadecimal codes. Editing procedures for the UCP edit screens were inconsistent and cumbersome. Finally, operators had difficulty locating information in the PUP and UCP user's manuals.

5.18.1.2 The averages for the maintenance SUQ indicated generally unfavorable usability characteristics for the evaluated interfaces. For similar functions, the MCC and UCP menu structures and commands were unnecessarily different. The maintainers were often required to copy important information by hand because printers were not available to support the maintenance software interfaces. Finally, the technical documentation for the diagnostic interfaces did not adequately describe needed procedures or error messages.

5.18.2 Recommendations.

5.18.2.1 For JSPO:

a. Ensure adequate PUP and UCP user's manuals are provided with an index. (SR 403)

b. Include adequate menu editing procedures in the PUP and UCP users' manuals. (SRs 544, 543, 226, 333, 040, 175)

c. Provide adequate technical documentation for the Ramtek diagnostics, the RDASOT, and the MCC to include meaning and impact of error and status messages. (SRs 129, 384, 355, 048, 066, 117, 151, 479, 388)

d. Eliminate any use of hexadecimal code for character or numeric input. (SRs 415, 438)

e. Eliminate inconsistencies in UCP and PUP editing screens. (SRs 029, 250, 309, 015, 175, 161, 039)

f. Provide compatible interfaces for the MCC, UCP, and PUP. (SRs 057, 164, 143)

g. Enable applications terminals to accept keyboard entries during screen updates. (SRs 167, 155)

h. Improve RCM editing procedures. (SRs 358, 333, 336, 428)

i. Provide effective multiple RPG dialup procedures from the PUP. (SRs 395, 393, 394, 415, 515)

5.18.2.2 For JSPO and users: Provide a print capability at the RDA, RPG, and PUP to support the Ramtek, RDASOT, and the Concurrent Computer Corporation diagnostics and the MCC interface. (SRs 181A, 082, 069, 125, 469)

5.19 OVERALL PERFORMANCE.

5.19.1 Conclusions.

5.19.1.1 When the overall performance of NEXRAD was considered, the median questionnaire response of all the operators indicated that the system did not meet their requirements as an aid for preparing weather warnings, weather advisories, and routine weather services (see page A-2). Most operators stated that NEXRAD was often not available to support these services because of PUP lockups, system outages, and problems with recovering automatically from power transitions. However, possibly because of their smaller area of weather support responsibilities, DOD median questionnaire responses indicated that the system met their minimum operational needs when the overall NEXRAD performance was considered.

5.19.1.2 When the operators considered the overall responsiveness of the system in a multiple user environment the median questionnaire response of the operators indicated that the system met their minimum operational needs (see page A-2). However, possibly because of their larger weather support areas, DOC and DOT median questionnaire responses indicated that the system did not meet their minimum operational needs when the overall NEXRAD responsiveness was considered.

5.20 FOLLOW-ON OPERATIONAL TEST AND EVALUATION. To refine estimates of operational effectiveness and suitability and to evaluate changes and modifications made to correct deficiencies identified by the IOT&E(2) test team, the using agencies should address the following areas during FOT&E. FOT&E should be performed in an operational, multiuser environment that includes associated and nonassociated PUPs from all using agencies during a significant weather season. The system should include limited and/or full-scale production phase capabilities of the hydrology algorithms, full RPGOP communications speed, and the limited and full-scale production phase algorithms. Organizational-level maintenance should be performed on a production-model NEXRAD using validated and verified technical manuals, the integrated logistics support infrastructure, and representative training. The OSF should generate and test a new software version release well in advance of the SMRT to include adding, deleting, and changing functionality within the RDA, RPG, and PUP.

APPENDIX A - MATRIX OF OPERATIONAL TEST RESULTS

EVALUATED

EFFECTIVENESS OBJECTIVES

"WHEN OPERATING"*

Objective	All Operators	DCC	DOD	DOT
Weather Warnings (E-1)	M(4)	M(4)	M(5)	--
Operator Workload (E-2)				
PUP Only	M(2)	M(2)	M(2)	D(1)
PUP and UCP	D(1)	D(1)	D(1)	--
Multiple Users (E-4)	M(4)	M(4)	M(5)	D(3)
Weather Advisories (E-5)	M(4)	M(4)	M(5)	M(4)
Routine Services (E-6)				
Short Range Forecasts	M(4)	M(4)	M(5)	M(4)
DOD Surface Observations	M(4)	--	M(4)	--
Weather Briefings	M(4.5)	M(4)	M(5)	M(4)
DOT Traffic Management Briefings	M(4)	--	--	M(4)

M = Met requirement
D = Did not meet requirement
-- = Not applicable

NOTE: Numbers in parentheses are the median operator questionnaire response ratings. For objectives E-1, E-4, E-5, and E-6 the criterion was a rating of 4 or greater on a 6-point scale (ranging from 1 = completely ineffective to 6 = completely effective). See table II-2 for response scale. For objective E-2, the criterion was a median rating of 2 or greater on a 5-point scale. See table II-3 for response scale.

*Operators' responses for these evaluations were based on only when the system was operating.

EVALUATED

EFFECTIVENESS OBJECTIVES

"OVERALL PERFORMANCE"*

Objective	All Operators	DOC	DOD	DOT
Weather Warnings (E-1)	D(3)	D(2)	M(4)	--
Operator Workload (E-2)				
PUP Only	M(2)	M(2)	M(2)	D(1.5)
PUP and UCP	D(1)	D(1)	D(1)	--
Multiple Users (E-4)	M(4)	D(3)	M(4)	D(1)
Weather Advisories (E-5)	D(3)	D(2)	M(4)	D(2)
Routine Services (E-6)				
Short Range Forecasts	D(3)	D(2)	M(4)	D(2)
DOD Surface Observations	D(3)	--	D(3)	--
Weather Briefings	D(3)	D(2)	M(4)	D(2)
DOT Traffic Management Briefings	D(1)	--	--	D(1)

M = Met requirement
D = Did not meet requirement
-- = Not applicable

NOTE: Numbers in parentheses are the median operator questionnaire response ratings. For objectives E-1, E-4, E-5, and E-6 the criterion was a rating of 4 or greater on a 6-point scale (ranging from 1 = completely ineffective to 6 = completely effective). See table II-2 for response scale. For objective E-2, the criterion was a median rating of 2 or greater on a 5-point scale. See table II-3 for response scale.

*Operators' responses for these evaluations were based on overall performance including impacts of PUP lockups, system outages, and problems with automatically recovering from power transitions.

EVALUATED

SUITABILITY OBJECTIVES

Objective	Results
Maintainability (S-13)	
MTTR	D
Isolated to a single LRU	D
Isolated to 3 or fewer LRUs	D
Availability (S-14)	
Full System	D
Degraded System	D
Software Maintainability (S-16)	
Documentation	M
Source Listings	M

M = Met requirement
D = Did not meet requirement

APPENDIX B - PRIORITIZED LIST OF CATEGORY I SERVICE REPORTS

List of Prioritized Category I Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
1	168	Safety - Unsafe Power Down Procedures for Component Replacement
2	012	Safety - Hazards Associated with the Use of Radome Davit Assembly
3	010	Safety - Hazards with Large Radome Hatch Cover
4	264A	Personnel Hazard Due to Potentially Unprotected Hatch Opening
5	262A	Personnel Safety Hazard When Opening the RDA or RPG Tower Room Floor Hatch
6	190	Safety - "Eye Wash" Required in RDA Generator Shelter
7	189	Safety - Hazard Associated With Exhaust Fan in Generator Shelter
8	011	Safety - Inadequate Safety Railing Around Large Radome Hatch Opening
9	009	Safety - Hazard Associated with Entry/Exit Radome Hatch Opening
10	076	Safety - Inadequate/Inappropriate Fire Suppression Systems at IOT&E(2) Principal User Processor (PUP) Sites
11	049	Safety - Generator Shelter Entrance Hazard
12	061A	Unusable Handrail in Tower

APPENDIX C - PRIORITIZED LIST OF CATEGORY II SERVICE REPORTS

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR#	Title
1	098B	Potential Transmitter Reliability Problem
2	531	Too Many System Status False Alarms
3	317	Transfer Between Commercial and Back-Up Power Frequently Forces The RPG into an Inoperable Condition
4	206	Spare Transmitter Line Replaceable Units' (LRUs) Configuration Not Compatible with System Under Test
5	083	Frequent Ramtek Graphics Processor Lock-Ups
6	072B	Undefined RDA Alarms
7	006B	Erroneous Failure Messages on System Status Menu
8	087B	Failure of Automatic RPG Restart
9	014	Chapter 5 Preliminary Technical Manual (PTM) Inadequate
10	265A	Preliminary Technical Manual Deficiencies
11	129	Inadequate Documentation of System Status Messages at the RDA, UCP, and PUP Applications Terminals
12	530	Deletion of and Difficulty in Viewing System Status Messages at UCP and PUP
13	010A	Loss of Radar Data
14	396	New Correction Factors for Suncheck Measurement Subtest 1 (Align Pedestal) Will Not Update Correctly
15	168A	Audio Alarms at the UCP
16	437	Numerous PUP Deficiencies Apparently Related to Graphic Display of Status Messages
17	219	Degraded Operational Utility of Base Velocity Products Due to Range Folding
18	002B	Transmitter Faults Causing Wedges of Missing Data
19	440	Numerous Discrepancies in "RDA Calibration" Procedures
20	164A	Calibration of NEXRAD Unit
21	400	Corrupted Links In Database File
22	112A	Failed Power Transistor
23	138A	Undefined PUP System Status Messages
24	166	System Does Not Stay On Auxiliary Power When Switchover is Commanded From the UCP or the RDA Maintenance Terminal
25	017	Orderly Shutdown of RDA at RDA Shelter Not Possible
26	391	Safety - Inadequate Warning/Caution Signs Throughout NEXRAD
27	227	NEXRAD Transmitter Field Maintenance Manual (NWS EHB 6-514) Inadequate
28	500	Apparent Velocity Dealiasing Errors
29	196	Recenter/Magnify Product Function Unreliable
30	328	NEXRAD Commercial Manuals of The Preliminary Technical Manual (PTM) Inadequate
31	384	Inadequate Procedures in RDASOT User's Guide for Generation of Clutter Map
32	463	Safety - Personnel Hazard Associated With the Fixed Ladder Attached to the Antenna
33	027B	Need for Audio Alarm for Free Text Message (FTM)
34	138	Chapters 1-4 and 6 of Preliminary Technical Manual (PTM) Inadequate
35	286	Safety - Inadequate Warnings Located in Chapter 5, Preliminary Technical Manual (PTM)

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
36	009A	Need for Alert of System Failure
37	420	RDA Transmitter Beam Voltage Calibration Data Not Available
38	207	Safety - Inappropriate Method to Bypass Interlock Switch S4 in Transmitter Cabinet
39	087	Excessive Acoustic Noise Associated With PUP Cabinets
40	133	Safety - Noncompliant Grounding and Bonding
41	544	Incomplete Information in UCP User's Manual
42	352	Source Listing Preface Block Inadequacies
43	496	Deficient Software Documentation Characteristics
44	404	Safety - Inadequate/Unsafe Radome Obstruction Light Access
45	251	RDA System Operability Test (RDASOT) User's Guide of Preliminary Technical Manual (PTM) Inadequate
46	543	Incomplete Information in PUP User's Manual
47	178	Inadequate Free Text Message (FTM) Receipt Notification
48	169	Safety - Problems Associated With Fire Suppression System at RDA
49	062B	Apparent Velocity Aliasing
50	357	Safety - Inadequate Tower Safety Features
51	187	Insufficient Storage Space On-Site for Generator- and RDA-Related Support/Maintenance Items
52	403	Alphabetized Indexes for PUP User's Manual and UCP User's Manual Not Available
53	174A	Unrealistic Radials of Data on the Base Velocity Product
54	354	Inability to Center Detected RF Pulse During RF Pulse Bracketing Alignment
55	368	Archive IV Optical Disk Frequently Unable to Support "Archive Write" Functions
56	239	NEXRAD Pedestal System Operation and Maintenance Manual Inadequate
57	047B	Inadequate Plans for Proposed RDA Shelter Interior
58	502	Excessive Narrowband Loadshedding of Routine Product List (RPS) Products During Widespread Weather Situations
59	506	"Range-Folding" Apparently Caused by Clutter Residue
60	169A	Lack of Manual RDA Maintenance Diagnostic Procedures
61	497	Deficient Software Source Listing Characteristics
62	323	Inadequate Data Dictionaries
63	533	Safety - Unsafe Procedures for Access to Components Located at the Top of the Pedestal
64	059	Unable to Specify a Start Time of Data for PUP Training Mode
65	271A	Undefined Alphanumeric Keys
66	160	Layered Composite Turbulence Maximum (LTM) Values Do Not Correspond to Observed Turbulence Reports
67	061	Optical Disks Jam in Optical Disk Drive Units
68	050	"CITY" and "COUNTY NAMES" Maps Not Available
69	032	Safety - Easily Accessible Main Power On/Off Switches Required
70	098	Safety - No High Voltage Warning Signs on Exterior of Transmitter Cabinet or on Internal High Voltage Points
71	113	Safety - Telephone/Intercom Communications in Radome Area Not Available
72	e139A	Communication Status Messages

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
73	301	Graphics Processor Locks-up When Attempting to Display Products With Apparently Erroneous Data
74	532	Safety - Captive Fasteners Not Used Where Required by MIL-STD-1472C
75	335	Descriptions of Complicated, Mathematical Algorithms/Calculations Not Available in B5 and C5 Documentation
76	295	Functionality for Modifying Current Volume Coverage Pattern (VCP) Not Available
77	058A	Excessive Noise Level in Operations Room
78	285	Safety - Power Down Requirements and Procedures for Preventive Maintenance Inspections Not Specified
79	383	Failure of PUP Applications Software to Verify Results of Operator-Initiated Commands
80	264	RDA System Operability Test (RDASOT) Will Not Execute After RDA Applications Software is Reloaded
81	228	Rings of Missing Data on Base Products for 2.4 Degrees Elevation Slice
82	159	Disconnected Cables/Wires in RDA Cabinets
83	096	Inadequate Design of RDA Shelter to Meet Maintenance Requirements
84	416	Procedures to Use RPG Local Maintenance Terminal Not Available
85	104A	Incorrect NEXRAD Status Displays
86	135	RPG Maintenance Console Not Fully Functional
87	055	Safety - Inadequate PUP Cable Routing
88	208A	Inadequate Labeling of Line Replaceable Units (LRUs)
89	018	Programmable Signal Processor (PSP) Download Error When Attempting to Run RDASOT Diagnostics
90	439	Description of System Console Mnemonic Codes and Messages Not Available
91	077	Inadequate List of UCP System Console Commands in Preliminary Technical Manual (PTM)
92	052	Safety - Insufficient Clearance to Shut Concurrent 3212 Cabinet Door With Control Panel Key in Place
93	279	Problems Associated With The Display of Products Recorded on Archive III
94	297	Frequent Degradation of RDA Maintenance Terminal Operations
95	088B	Automatic RPG-PUP Communications Line Connection Failure
96	441	Degradation of VAD Winds and Velocity Dealiasing Algorithm
97	108A	Inconsistent Velocity Patterns
98	111A	System Dependence on Environmental Control Equipment (Air Conditioning)
99	399	Inadequately Documented "FILE ADDRESS ERROR" Messages Received During Time Lapse Operations
100	288	Inadequate Documentation for Optical Disk Recovery Procedures
101	332	Potential Reliability Problem Associated With 5 1/4" Optical Disc Drive Power Switch
102	181A	Printer for UCP Alphanumeric (A/N) terminals
103	212	Insufficient Information on Performance Data in RDA User's Guide
104	208	Inadequate Output Available from Mesocyclone Product
105	026	Pulse Forming Network (PFN) Schematic Not Available in Preliminary Technical Manual (PTM)

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
106	382	Safety - Emergency Lighting and Exit Sign Not Available in RDA Shelter
107	310	Safety - Problems Associated with PUP Workstation Power Strip (UD45A3)
108	149	Suspected Reliability Problem With the Pulse Forming Network (PFN) Switch
109	003	Undocumented Operation of the Auto Display Mode
110	167	Intermittent Response to <RETURN> and Function Keys When Entering Commands at the UCP and PUP Applications Terminals
111	490	Apparent Message Framing Inconsistency Between PUP and RPG and Inadequate Technical Data Support
112	245A	Noncompliant Grounding and Bonding
113	329	Safety - Uncovered Voltage Terminal Block in RDA Data Processor (UD5) Cabinet
114	120	Capability to List the Directory of the Data Stored on an Archive III or Archive IV Optical Disk Not Available
115	380	Apparent Inappropriate Indications of Hail from the HAIL Product
116	387	Safety - Pedestal Platform Bolts Not Safely Accessible
117	059A	Slow Response on Alphanumeric Terminals
118	395	Insufficient Capability to Dial Non-Associated RPGs
119	197	Inadequate Documentation on RDA Data Processor (RDADP) Power Supply 5/6 (PS5/PS6) and Power Supply 7 (PS7)
120	435	Procedures to Transfer UCP Functionality from UCP to RPG Local Maintenance Terminal Not Available
121	517	Inability to Read Status Files Archived at Separate Times
122	315	Safety - Improper Location of the RDA Halon Manual Discharge and Abort Stations
123	093	Safety - RDA Data Processor (RDADP) Power Supply Test Points to Close to Measure Safely
124	202	Test Equipment and Tools Not Available to Perform Hitachi Adjustment and Test
125	413	RDA Applications Software Did Not Run When the Antenna Exceeded the Elevation Electrical Limits
126	186A	Inadequate Training and Documentation on the Causes of Load Shedding
127	124	Inadequate Labeling/Marking of NEXRAD Equipment
128	525	Inadequate Base Velocity Display
129	130A	Missing Base Data Using Scan Strategy 11
130	084B	Need for Selected Print Capability for System Status File
131	224	Archive III Products Occasionally Contain Inappropriate Data Levels
132	167A	Switch Setting Documentation
133	096A	Suspected Erroneous Layer Composite Turbulence Products
134	201	Inadequate Technical Data for RDA Data Processor (RDADP) Power Supplies (PS)
135	355	Inadequate Procedures and Functionality to Update RDA Adaptation Values
136	393	Inadequate, Time-Consuming Procedures for Acquiring Background Maps from Non-Associated RPGs
137	243A	Accessibility Problem with PUP Processor/Communications Cabinet
138	125A	Incorrect Fuse Labeling

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
139	422	Automatic Pulse Repetition Frequency (Auto PRF) Modification Functionality Apparently Not Working
140	480	PUP Card Strapping and Switch Settings Did Not Match the Preliminary Technical Manual (PTM)
141	401	Inadequate Documentation of RPG Product Limitations
142	482	Klystron and System Power Indications During Warm-up Not Documented
143	446	Inadequate Period of Retention of Free Text Message (FTM) Products
144	268	Inadequate RDA Cable Assemblies
145	447	Inadequate Functionality of PUP Free Text Message (FTM) Product
146	402	Edited Clutter Suppression Region Adaptation Data Reverting to Zeroes Following "RPGUP"
147	130	Inadequate Notification of RDA Request for Local Control
148	173	Verification Prompts Required for UCP Commands Which May Have a Significant Impact on NEXRAD Operations
149	542	Problems Associated with PUPUP and RESTART Command
150	493	Index for CPCI C5 Documentation Not Available
151	176	Frequent, Unrequested Cleared Screens When Displaying Products in Quarter Screen Mode
152	324	Inconsistent and Inappropriate Amounts of Data Retrieved From Archive IV
153	516	Functionality to Read and Display Archived Status File From Archive IV Inoperable
154	538	Safety - Water in RDA Cable Vault
155	082B	Unterminated Input at UCP System Console Halts RPG
156	095A	Unavailable Geographic Annotations
157	499	Possible Base Data Positional Inaccuracy
158	394	Inadequate Procedures for Requesting More Than One Product When Dialing a Non-Associated RPG
159	294	Base Reflectivity Product Occasionally Contains Azimuthal Appendages of Reflectivity
160	511	Initialized Optical Disk Unusable After Reinitialization
161	325	Archive IV Problems when Archiving Entire Product Database
162	282A	Halt of Product Reception when "RPG ERROR" Messages are Received
163	271	Inability to Ascertain Data Level of a Particular Image Display Element in a Timely Manner
164	457	Auto Archive III Did Not Automatically Restart After an RPG Restart
165	062A	Lost System Status log
166	415	Inadequate Procedure to Update RPG Directory (Extended Adaptation Parameter, Category 11)
167	228A	Numerous False Alerts from Mesocyclone Detection Algorithm
168	410	Inadequate Storage Time for Background Maps from Non-Associated RPG
169	248	RDA Performance and Maintenance Data Information Not Updated Before Being Displayed
170	231	Safety - Receiver Cabinet Hazard Caused by Improper Mounting of RF Frequency Generator
171	005	Concurrent Functional Schematic 35-77OdO8, CPU-D Not Available

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
172	414	Dissimilar Data Element Names in C5 Documentation and Source Listings
173	250	A Undesired Automatic Scan Mode Change
174	112	Documentation on Antenna Pedestal Level Specifications Not Available
175	537	Safety - Insufficient "ON" Period for RDA Halon System Discharge Warning Indicator
176	381	Inadequate Clearance Between Cabinet and Facility Wall to Allow Access to Ramtek Circuit Cards
177	056	Safety - Inadequate Fastening Method for RDA Receiver Cabinet Electromagnetic Interference (EMI) Filter
178	200	Inadequate Documentation of Status Messages Which Refer the Operator to a Software Technician in PUP/RPGOP User's Manual
179	036	Inadequate Marking of Voltage Terminals in the Transmitter
180	004	Undocumented Error Code and Recovery Procedure for Keyboard Lockup at PUP Applications Terminal
181	061B	Anomalies in One-time Requests
182	515	Inability to Quickly Identify and Enter the RDA/RPG Mnemonic for Dialing Up an Nonassociated PUP
183	346	Front Door to RDA Data Processor (RDADP) Cabinet (Left Bay) Not Available
184	265	Setup Procedures for Micro Junior Fire Control Panel Circuit Board (UD1A5A1) Not Available
185	484	Inconsistent PUP and RPG "Time to Begin Edit" and Time to Edit" Checks for Radar Coded Message (RCM) Products
186	008	"CONTINUE ON ERROR" Option Does Not Work in RDA System Operability Test (RDASOT)
187	290	CPCI-01 Documentation Problems
188	e073A	Uniform Software Commands
189	405	Safety - No Fire Protection Equipment Located in Radome Area
190	132	Unorganized Cable and Wire Routing of Receiver Cabinet and RDA Data Processor (RDADP) Cabinets
191	378	Inadequate Documentation for Special Test Programs
192	101	Preliminary Technical Manual (PTM), Table 5-2.11 Not Available
193	170	Software and Procedures Required to Run RDA Special Test Programs Not Available
194	289	CPCI-04 Documentation Problems
195	360	Erroneous Pick-A-Product Operation
196	522	Undocumented Radial Overlap on Base Products
197	407	Inconsistencies Between Communications Interface User's Guide for Class III and Class V Users and Redbook
198	053	Safety - AC Outlet Not Available in Left Rack of RDA Data Processor (RDADP)
199	421	Ring of Missing Data on LAYER COMPOSITE TURBULENCE MAXIMUM - MIDDLE LAYER (LTM) Product
200	412	Inaccurate/Incomplete Documentation of Attenuator Pads and Values
201	535	AGC (Automatic Gain Control) Alignment Procedures Were Time Consuming and Required Special Test Fixture
202	241	Current Operational Status of Archive III Not Available
203	492	Inadequate Table of Contents for Each CPCI C5 Documentation

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
204	337	Failure of UCP Command to Connect Communication Line for an Individual Associated PUP
205	258A	Cumbersome and Time Consuming Radar Coded Message (RCM) Editing Procedures
206	351	Archive IV "Append/Read By Time Span" Functions Unreliable
207	078	Some Transmitter Voltage Standing Wave Ratio (VSWR) Fault Adjustment Equipment Not Available
208	453	Inadequate Applications Training on Adaptable Parameter Changes
209	458	Inadequate AIRWAY LOW, AIRWAY HIGH, and NAVAID Background Maps
210	256	Insufficient RDA Concurrent 3212 Internal Cabling Data
211	089A	Product Inaccuracies Produced by Archive Level III Record and Playback
212	077B	Lubricants Leaking at Antenna Pedestal Assembly
213	e344	Need for PUP User's Manual to Contain PUP Power On/Off Procedures
214	262	Inconsistent Part Numbers on Line Replaceable Units (LRU) and Part Numbers Listed in Preliminary Technical Manual (PTM)
215	476	Safety - Diesel Generator (UD10) has Fuel, Oil, and Exhaust Leaks
216	390	Error When Attempting to Display Products Read From Archive IV
217	028	Safety - Inadequate Guards and Warning Signs In Generator Shelter
218	023	Concurrent 3212 M80 Extender Board Not Available
219	214	Safety - Hazardous Exterior Air Vents at Generator Shelter
220	081B	Expanded-view Diagrams Not Included in Preliminary Technical Manual (PTM)
221	048	Undocumented RDASOT Subtest Error Messages
222	033B	Need for Self-retaining Inserts for Mounting Klystron Air Flow Sensor
223	429	Inadequate PUP Status on NEXRAD Unit Status Graphic Display
224	374	CPCI-30 Documentation Problems
225	001	Safety - Sharp Corners on Audio Alarm Case
226	300	Method for Viewing Hidden RDA Static and Occurrence Alarms Not Available
227	481	Maintainer-Initiated RDA "System Test" Not Available
228	312	Appropriate RDA Waveguide Port Attenuation Figures Not Available
229	445	Inadequate Method to Display Multiple Free Text Message (FTM) Products
230	e218	Need for Capability to Monitor Remote UCP at RPG Location
231	340	Inadequate Description of Software Status Messages in CPCI-04 C5 Documentation
232	097	Undocumented Procedures for Bidirectional Coupler Replacement and Calibration
233	267	Capacitor Analyzer Not Available
234	170A	Inadequate Contour Algorithm
235	483	Oscilloscope With Storage Capability Required for Transmitter Troubleshooting
236	083A	Inconsistent Vertically Integrated Liquid (VIL) and Severe Weather Probability (SWP) Values
237	127A	Inconvenient Location of Fiber Optic Transceiver
238	509	Inadequate Indication of Space Remaining on Archive Optical Disk

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
239	353	Inaccurate Documentation for Performing Transmitter RF Pulse Bracketing Alignment
240	185	Inability to Properly Connect High Voltage Power Supply Test Cable With High-Voltage Connector
241	145A	Difficulties in Synchronizing NEXRAD Unit Clocks
242	e221	Backup Diagnostic Tapes for the 3212 and 3280 Concurrent Computer Are Not Available
243	090	RPG Power On Sequence Documentation Inadequate
244	027	Safety - Wideband Communications Equipment Not Properly Mounted
245	019	Function Key Templates Not Available for All PUP Applications Terminals (Concurrent 6312)
246	327	Initial Transmitter Test Equipment Control Settings Not Documented
247	004A	Misplaced Radials
248	093A	Missing Names of Airports and Counties
249	291	Inadequate RDA Generator Fuel Level Indications
250	363	Wrong Index Values and Missing Checks in Module A403YE_RES_RQST_RESP
251	259	Safety - Tripping Hazard Associated with Electrical Conduit in Radome
252	459	Occasionally Unable to Cancel Archive Read
253	539	Opening Radome Hatch Did Not Cause "RADOME ACCESS HATCH OPEN" Alarm at RDA and UCP Consoles
254	073	Bidirectional Coupler Not Calibrated for Total NEXRAD Frequency Range
255	508	Product Annotation/Status Area of Graphic Display Difficult to Use
256	094	Unable to Complete Concurrent 3200 Series Multiple Peripheral Controller (MPC) Diagnostics Test
257	254	"<U>nit Control, <R>estart" Command Frequently Does Not Automatically Restart the RPG
258	e013	Need for an Easily Executable Method to Save and Load Adaptation Data Under Operator Configuration Control
259	057	Inoperative "DISPLAY PERFORMANCE DATA" (DIPD) Command at RDA Maintenance Control Console (MCC)
260	158	Input "ffer (Wideband) Loadshedding
261	397	Archive IV "OPTICAL DISK FULL" Message Not Received
262	191	Inadequate UCP "COMMUNICATIONS STATUS" Menu and Support Documentation
263	252	Preliminary Technical Manual (PTM), Revision "C", Chapter 5, is Missing Maintenance Procedures
264	071	Safety - Location of Archive Device Routinely Exposes PUP Circuit Boards to Accidental Damage
265	468	Inadequate Maintenance Concept for Color Graphics Printer
266	314	PUP Cables Being Damaged in Concurrent 3212 Processor Chassis
267	e150	Need For "NEXRAD UNIT STATUS" Products to Include Information on Meteorological Impact of Alarm Conditions
268	064	Inability to Perform Concurrent 3212 Error Logger Test #250, Subtest 4 Diagnostics
269	095	Unable to Perform Voltage Standing Wave Ratio (VSWR) Measurements
270	031	Safety - Inadequate Access to Voltage Measurement Points in RDA Data Processor (RDADP) Cabinet

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
271	193	Incorrect Narrowband Communications Line Status Displayed Following a Narrowband Line Disconnect
272	225	Safety - No Power Switch for Radome Heater in Radome
273	474	Radio Frequency (RF) and Intermediate Frequency (IF) Test Monitor Component Location Impairs Maintenance
274	223	Attributes Table Not Archived With Composite Reflectivity Product on Archive III and IV
275	062	Time Lapse "CONTINUOUS LOOP" Occasionally Stops Without Operator Interaction
276	249	Erroneous Data Occasionally Appears in Lowest Two Elevation Slices of Base Data Products
277	477	Illustrated Parts Breakdown (IPB) Not Available
278	e164	Confusing Commands on RDA Control Menu at UCP and Main Menu at RDA Maintenance Control Console (MCC)
279	118	Safety - Removal of Transmitter Modulator Pulse Assembly Top Cover May Damage Printed Circuit Board UD3A12A8
280	016	Concurrent 3212 Power Supplies (P5 and P5U) are Too Heavy for Supports
281	230	Inadequate Color Graphics Printer Maintenance Documentation
282	240	Initial Archive IV Status Information Inappropriate if Optical Disk Not in Optical Disk Drive
283	203	PUP Does Not Display Latest Available Severe Weather Products
284	349	Deficiencies Associated With "RIVER BASIN" Map
285	006	Inadvertent Tripping of Concurrent 3212 Power Supply Circuit Breaker (CB)
286	495	Unique Naming Convention For Global Data Elements Not Used
287	255	Halon Gas Pressure Gauge and Motorized Damper Assembly PMIs Procedures Not Available
288	151A	Loss of Operator-entered Parameters During Reboot
289	307	Incorrect Centroid Heights in Part C of the Radar Coded Message (RCM)
290	238A	Missing Information on Rivers Background Maps
291	308	Inconsistent Height Values for Winds in the Radar Coded Message (RCM), Part B
292	419	Unambiguous Velocity/Range Information Not Readily Available for Velocity Products
293	103	Unable to Perform Transmitter Oil Dielectric Strength Test
294	022	Inability to Exercise Small Computer System Interface (SCSI) Using Copy Task "COPY32" as Indicated in PTM
295	487	Inadequate System Dump Analysis Procedures
296	491	Inefficient Format for CPC Descriptions in the C5 Documentation
297	066	Undocumented Concurrent 3212 Subtest Error Messages
298	367	Archive III Loadshed Warning Message Not Displayed
299	073B	Inadequate Loadshed Category Information
300	417	RF Pulse Shaper Waveform Checks Procedures Not Available
301	541	Crash Codes Not Documented
302	526	Inadequate and Duplicative Interface Information in ICD and Communications Interface User's Guide
303	065B	Inadequate Weak Echo Region (WER) Product
304	042	Intermixed Archive II and Archive III Functions on Same Menu

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
305	248A	Inadequate Training on Dial-up Procedures
306	e246	Need for Adequate Method to Notify Technician at RDA Site That Telephone is Ringing
307	362	CPCI-06 Documentation Problems
308	e236A	Need to Save, Load, and Catalog Adaptation Data Files
309	010B	Inadequate Quadrant Display of One-time Requested Products
310	408	Inadequate "Elevation Up" and "Elevation Down" Functionality
311	430	Inadequate Range of the VIL Product
312	117	Inadequate Ramtek 4660 Diagnostics Test 10 Documentation
313	272	Inadequate Documentation on the Effects of Powering Down Data Acquisition Unit (DAU)
314	088	Inadequate Cabinet Door Hinges
315	245	Procedures for Use of RDA 3212 Processor Multiple Peripheral Controller (MPC) Diagnostics Not Available
316	151	Inadequate Ramtek 4660 Diagnostics Test 14 Documentation
317	e255A	Need for Display of RDA/RPG Performance and Maintenance Data
318	514	Non-Receipt of Products Via Dial-up When WARNING AREA or RDA Maps are Associated with Product
319	002	Loss of Time Lapse Parameters Following a PUP Shutdown and Restart
320	342	CPCI-03 Documentation Problems
321	081	Terminal Configuration Data Not Available
322	162	Failure to Display Most Current Version of Selected Products When in Training Mode
323	281	Inadequate "RIVER" Map
324	296	Safety - Problems Associated With RDA Shelter Door
325	080	Safety - Data Acquisition Unit (DAU) Maintenance Panel Hazard
326	418	Graphics Lock-up Apparently Associated with Color Printer Paper Jam
327	545	Inability to Adequately Specify Required Frequency of Archive III Products
328	194	Inability to Designate One-Time-Requested Products for Automatic Archiving on Archive III
329	038	Safety - Line Replaceable Units (LRU) In Excess of One-Person Lift Values Not Labeled
330	268A	RPG Can Generate Only Two Reflectivity Cross-section (RCS) Products per Volume Scan
331	122	Inadequate Editing Capability for High Resolution "CITY" Map
332	193A	Loss of Velocity Azimuth Display (VAD) Data During RPG Reboot
333	338	Archive IV Commands to Archive and Read Received Background Maps for a Selected RPG Not Available
334	136	Undocumented Archive Level IV Error Messages
335	084	Unable to Perform Transmitter Meters A1M1, A1M2, A1M3 Adjustments
336	386	Inappropriate Alarms on the Wideband Fiber Optics Transceiver
337	226	Safety - Hazardous Condition Associated with Transmitter Intake Air Vent
338	094A	Metric Units
339	479	Inadequate Documentation on RDA Maintenance Terminal Options
340	229	Inadequate Method to Remove PUP Ramtek Graphics Processor Hard Cursor Card (UD41A13A4)
341	528	Passwords Used Within the Functional Areas Not Available

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
342	142	Inadequate Documentation to Determine Average Pulse Repetition Frequency (PRF)
343	438	Inadequate User Interface for Extended Adaptation Editing Procedures
344	034B	Strain Relief Needed on Transmitter Multiconductor Cable
345	518	Inability to Read Background Maps From Archive IV
346	442	Inadequate Storm Tracking Algorithm
347	092	Accessibility Problem with Modulator Pulse Assembly (UD3A12)
348	292	Improper/Missing Cable Hardware
349	448	Product Forward/Back Function on Alphanumeric (A/N) Terminal Unavailable
350	347	Damaged RDA Data Processor (RDADP) Cabinet Cable 5A10J21
351	361	Procedures to Inspect and Clean Azimuth Sliprings and Brushes Not Available
352	540	RDA Maintenance Terminal Displayed Garbled Data When Using Page Backward Command in Receiver Adaptation Tables Screen
353	304	FMH 11:Inadequate Documentation for Storm Attributes Overlay
354	153	Inadequate Suspension of Waveguide Switch Assembly
355	472	Inadequate Crimp-on Connectors Used on PUP Line Filter (UD41FL1) Power Cable
356	144	Inadequate Routing of RDA Receiver Cabinet (UD4) Log Video Cable
357	478	Access to AGC Threshold Control Not Visible During Maintenance
358	139	Operation of RDA Data Processor (RDADP) Cabinet (UD5) Maintenance Panel (A2) Audible Alarm Not Documented
359	501	Inadequate UCP User's Manual Documentation for Archive III Automatic Archiving Procedures
360	155	Degradation of Applications Terminals' Responsiveness When Frequent Alarm Messages are Being Displayed
361	432	Ramtek Graphics Processor External Test Points Not Available
362	134	RDA Data Processor (RDADP) Cabinet Doors Will Not Close Due to Cable Routing
363	209	Inadequate Support Equipment to Perform Security Alarm Installation and Modification
364	e053B	Need for Ability to Display and Archive Algorithm-generated Parameter Values at the PUP
365	326	Inability to Archive Dial-up Background Maps to Archive IV
366	033	Safety - Inadequate Fastening Method in Transmitter High Voltage Cabinet
367	199	Inappropriate "PRESENT TIME" Function at PUP Graphic Tablet
368	192	Proper Tools and Support Equipment for Transmitter VSWR Fault Circuit Adjustment Not Available
369	049B	Need for Volume Coverage Pattern (VCP) Unambiguous Velocity and Range Information
370	454	Inappropriate Response to ELEVATION UP/DOWN Function Selection
371	059B	List of Dial-up Products Accessible by Nonassociated PUPs/RPGOPs Not Available
372	343	Inconsistent Documentation of Attenuation Path Used in RDA Calibration Calculations
373	253	Inadequate Weak Echo Region (WER) Product
374	498	Comprehensive Glossary for CPCI C5 Documentation Not Available

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
375	082	Insufficient RDASOT User's Guide Procedures for Recording and Printing Maintenance Session
376	232	Unable to Locate Transmitter Test Points on the A1A2 Module
377	507	Inadequate Capability to Specify Velocity Products Data Levels at PUP
378	186	Test Points for Transmitter Modules Difficult to Access When Transmitter is Operating
379	141	Information on Time Required to Complete Diagnostic Tests Not Available
380	217	Inability to Determine the Reliability of the Velocity Azimuth Display (VAD) Computed Wind
381	536	Inability to Complete PUP Color Monitor Adjustments
382	029	Inadequate Environmental Winds Editing Capabilities
383	467	RDA Display Performance (DIPD) Menus Incomplete and Not Adequately Documented
384	302	Inadequate Documentation to Correlate NEXRAD Product Formats With Redbook Transmission Blocks
385	311	Date Variable Improperly Incremented in Module A3052H__PRECIP_CATS
386	278	Accessibility Problem With the Radar Product Generation (RPG) Input/Output (I/O) Panel
387	e085B	Need for Uniform Free Text Message Send/Display Procedures
388	067	Safety - Inadequate Dummy Load Support
389	388	Inappropriate Messages on PUP Applications Terminal While Performing Ramtek Diagnostics Test 14 Subtest 1
390	070	Procedures for Initializing Opt12al Disks Not Available
391	126	Incorrect PUP User's Manual Instructions for Loading and Unloading Archive IV Optical Disks
392	102	Beam Voltage Proximity Sample Line Not Connected to the Transmitter Oil Tank Test Jack J1
393	358	Automatic Editing of Radar Coded Message (RCM) Parts A and C For No-Echo Conditions Not Available
394	266	Inadequate Clearance for Removal of Air Conditioner Economizer Filters
395	461	Inadequate Linking of Cursors in Dual Four Quadrant Graphic Mode
396	313	Inadequate RDA Shelter Waveguide Installation
397	377	Inappropriate Duplication of CPCI-24 Shared Modules
398	034	Safety - First Aid Kit Not Available at RDA Sh[illegible]ter
399	426	Maintenance and Replacement Procedures for [illegible]eed Horn Assembly and Waveguide Sections Forward of Reflecto[illegible] [illegible]ot Available
400	258	Security Panel Documentation Not Available
401	068	Deficiencies Associated With Transmitter Meter AIM4
402	069	Inadequate UCP Applications Terminal Screen Printout Capability
403	066B	Restrictions on User Functions
404	521	Apparently Inappropriate Error Message When Selecting Archive IV Auto Archiving Frequency
405	250	Edits of Current Generation and Distribution Control List Also Changes Adaptation List
406	392	PUP Workstation Color Monitors' (UD45) Control Knobs Not Securely Mounted

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
407	e128	Need for Capability to Quickly Identify Changed System Parameter on NEXRAD Unit Status Display Graphic
408	273	Unsecured Hardware on Pedestal Power Amplifier Air Filter (UD5A7)
409	527	Safety - Cover For Fluorescent Lamp in Transmitter Cabinet Not Provided
410	462	Generator Shelter Telephone/Intercom Communications Not Available
411	226A	Duplicate Use of Storm Identification Numbers
412	e021	Need for Metric Units/English Units Toggle Function
413	460	AUTO DISPLAY Functionality Not Available in Training Mode
414	243	Incorrect Coding of "Operational Mode" on Radar Coded Message (RCM) Alphanumeric Product
415	035	Safety - First Aid Kit Not Available at Generator Shelter
416	210	Inability to Modify Storm "TRACKING AND FORECAST" Default Speed
417	237	Source Code Files A317M3 and A317M4 Not Available
418	070B	Need for Test-point Markings on Transmitter Inner Door
419	e293	Color Graphic Printer Copy Counter Instructions Not Available
420	140	Incomplete Documentation on Receiver Power Supplies Voltage Tolerances
421	148	Inadequate Length of RDA Data Processor (RDADP) Pedestal Control Unit (PCU) Cable
422	099	Reference Designators on Waveguide Components Are Not Consistent With Unisys Technical Data
423	e235A	Need for Multiple Color tables for Each Product
424	065	Concurrent 3212 Design Inappropriate for Running MAT/CACHE Test Diagnostics
425	451	Inadequate Retention of Operator-Specified Storm Motion Parameter Values
426	320	FMH-11 - Hail Product Functional Description Does Not Document Hail Size That Algorithm Was Designed to Detect
427	072	Inadequate Fastening Method for Transmitter (Tx) Air Intake Filter Cover
428	471	RDA System Operability Test (RDASOT) Displayed Incorrect Maintenance Action
429	371	Commercial Manual for Diesel Generator Shelter Exhaust Fan Not Available
430	054B	Need to Specify Altitude Level on the Velocity Azimuth Display (VAD) Alert
431	e064B	Need for NEXRAD Unit Status Graphics Product to Display Automatically Upon VCP Changes
432	366	Inconsistent Time on Alert-Paired SEVERE WEATHER ANALYSIS - REFLECTIVITY (SWR) Product
433	370	Source Code Module A4CM40 Not Available
434	488	CPC-17 Modules Incorrectly Located with CPC-18 Modules
435	079	Procedures for Cleaning and Inspecting Concurrent 6312 Terminals Not Available
436	e220	Need for Improved Monitoring of RDA Area by Security System
437	e154	Need for an Easily Executable Method to Save and Load Unit-Radar-Committee (URC)-Controlled Adaptation Data
438	e011B	Need for Concurrent Screen Update Capability
439	e190A	Inconsistent Use of Coordinate Systems

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
440	411	Inadequate Radar Coded Message (RCM) Edit Audio Alarm
441	431	Missing Slices on WEAK ECHO REGION Product
442	123	"PRECIPITATION DETECTION" Edit Screen Rate Threshold Limits Too Low
443	104	Transmitter Oil Pump Motor Lubrication Holes Difficult to Access
444	e216A	Need for On-line Maintenance Logs
445	e224A	Need for Product-specific "CONTROL" and "PRODUCT" Edit Screens
446	180	Inadequate Default Weather Mode Functionality
447	165	Erratic Voltage Adjustment in the RDA Data Processor (RDADP)
448	373	Procedures to Perform the PUP Color Monitor Operational Check Not Available
449	184	Inability to Set Equalizer Functions on Fujitsu Modem
450	333	Inadequate Documentation in PUP User's Manual on Radar Coded Message (RCM) Editing Procedures
451	221A	Velocity Azimuth Display (VAD) Product Data Not Available at 1000 ft Intervals
452	045	RDA Data Processor (RDADP) Cabinet (UD5) Power Supplies (PS) Not Properly Labeled
453	504	Severe Weather Probability (SWP) Color Data Levels Not Included on Display
454	e348	Need for Capability to Retain Previous Graphic Product Manipulations for Use in Subsequent Product Displays
455	427	Cumbersome Procedure for Transmitting the Edited RCM
456	e183A	Need for Echo Tops Contour Overlay
457	280	Inadequate Detail on "HIGHWAY" Map--Both High and Low Resolution
458	183	Inability to Complete Codex 2260 Modem Retrain Function Test
459	406	Corrosion on Unprotected Area of Antenna Pedestal Torque Tube
460	099A	Lack of Navaid Legends
461	356	Noninterchangeable Alphanumeric Terminals and Noninterchangeable Keyboards
462	494	Incomplete Version Description Documents (VDDs)
463	e143	Need for Improved RDA Applications Terminal Menu Interface
464	303	Inconsistencies in Alert Units Between "ALERT THRESHOLD VALUES" and "ALERT PROCESSING EDIT SCREEN HELP SCREEN"
465	519	Inadequate Real-Time Simulation During Archive Retrieval in Training Mode
466	172	Inconsistent, Non-Standard Color Coding of Receiver (UD4) Power Supply 1 (PS1) Test Points
467	e046B	Need for Turbulence Alert
468	215	Inappropriate Error Message Following Modification of STF Default Direction Adaptation Parameter
469	283	Inadequate Documentation on RDA Pedestal Bolts
470	e071B	Need for Improved Method to Page Through Help Menus
471	336	Inability to Delete All Centroids From the Radar Coded Message (RCM) Graphic Product
472	e047	Need for Capability to Center Polar Grid at Any Desired Location
473	260	Technical Manual for RDA Shelter Thermostats Not Available
474	001A	Time Lapse Speed Inconsistent
475	107	Unable to Perform Cabinet Blower B3 Belt Tension Adjustment
476	137	Unattached Panel Stiffener/Cover Spacers

List of Prioritized Category II Service Reports Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
477	163	Color Selection Mode Does Not Automatically Cancel When Another Product is Displayed
478	e263	Need for "REDISPLAY LAST PRODUCT" Function to Retain All Previous Manipulations
479	309	Frequent, Unrequested Cancellation of the Graphic Color Selection Process During Left Graphic Screen Editing
480	030	Receiver Power Supply (UD4PS1) +VA Adjustment Not Labeled
481	098A	Unknown Product Ranges
482	503	Difference Between UCP User's Manual and PUP User's Manual Concerning PUES Port Background Map Distribution
483	040	Inadequate Documentation on Usage of Environmental Winds Edit Screen
484	012B	Inconsistent Archive Menus at the PUP and UCP
485	284	Radome Ventilation Fan Preventive Maintenance Procedures Not Available
486	444	PUP User's Manual "Cross Reference of Command5Functions" Not in Alphabetical Order
487	e331	Need for Overlay Product Showing Trend of Maximum VIL and SWP for Current Storm Centroids
488	257	PMI for Inspecting/Cleaning Pedestal Power Amplifier (UD5A7) Air Filter Not Available
489	e125	Need for Printer at the RDA Site
490	195	Inconsistent Operation of "CANCEL USER FUNCTION" Command
491	529	Incorrect Documentation of Test Equipment Configuration For Transmitter Alignments
492	147	Rear Panel of Wideband Fiberoptics Transceivers Will Not Close
493	204	"RAMTEK HARDWARE HELP SCREEN" Contains Inappropriate Procedures
494	449	Numerous Deficiencies in FMH-11, Part D, Chapter 4 (DRAFT)
495	e071A	Transmitter Voltage/Current Meter and Selector Switch
496	505	Training Mode Status Messages Not Available
497	466	Safety - Inadequate Mounting of AC Power Junction Box
498	473	Procedure to Verify and Adjust the Elevation Pre-limit and Final Limit Switches Not Available
499	e269	Need for Improved Contour Functionality at The PUP
500	244	Incorrect Switch Orientation on RDA Maintenance Panel (UD5A2)
501	277A	Need for Reset Function for Alerts
502	375	Pedestal Azimuth Assembly (UD2A1A3) Oil Sight Glass Leaking Oil
503	127	Automatic Archiving Does Not Restart Following a PUP Restart
504	e022B	Need for Simplified Color-table Editing Procedures
505	043	Inconsistency Between UCP Archive Help Screen Information, UCP Archive Menu, and UCP User's Guide
506	015	Inconsistent Threshold Editing Procedures within Alert Processing Edit Screen
507	534	Selected RDA Command Mnemonics for Installed Equipment and Function Not Executed
508	452	CITY Map Names Overlap in Quarter-Screen Mode
509	e510	Need for Improved Point Echo Rejection in Echo Tops Algorithm
510	298	Inadequate Method of Attaching Micro Junior Fire Control Panel (UD1A5) Terminating Resistors

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
511	238	Incorrect Calculation of Date in CPCI-28, CPC 3
512	434	Capability to Specify a PUP to Edit RCM Not Available
513	117A	Non-display of Islands
514	e277	Need for Additional Continuous Time Lapse Loop Functionality
515	261	Undocumented, Non-standard Implementation of "ADCCP FLAG" in Wideband Interface
516	376	RDA Transmitter Oil Level Sight Gauge Leaking Oil
517	319	Inconsistent Degree of Accuracy of Displayed Power Measurements
518	156	Missing Hardware on Cable Connector in RDA Receiver Cabinet (UD4)
519	489	Incorrect Location of COMMON Block A317C4
520	145	Inadequate RDA Data Processor (RDADP) Small Computer System Interface (SCSI) Ribbon Cable
521	060	Inadequate "CLUTTER MAPS HELP" Screen
522	222	Inconsistency Between Maximum VIL Value and Labeling of Color Category Used For Its Display
523	105	Improper Wiring of Transmitter Cabinet Blower Assembly B3
524	485	Inconsistency Between CPCI-01 C5 and Module A10698__CSU K_PED_POSIT
525	054	Incorrect Plug on RAMTEK 4660 Diagnostics Cable
526	e523	Need for Increased Vertical Resolution for Analyzing Echoes at Distant Ranges
527	109	Pedestal Azimuth Assembly Leaking Oil
528	110	Pedestal Elevation Assembly Leaking Lubricate
529	e424	Need for Linear Motion Estimates of Echo Features
530	e191A	Proposed Merger of Storm Structure (SS) and Storm Track Information (STI) Alphanumeric Products
531	236	Industrial Waste Disposal Container at Generator Shelter Not Available
532	475	PUP Workstation Audio Alarm (UD46) Front Panel Potentiometer Came Loose and Bent Easily
533	443	FMH-11 Part D, Chapter 2 and 3 (DRAFT) Inadequately Structured
534	334	Use of Nondescriptive Variable Names in CPCI-04
535	121	Graphic Timeout Occurs When Requesting a Hardcopy While Color Printer is Processing a Previous Request
536	464	Concurrent 3212 Power Supply Check Procedures Contained Unnecessary Steps
537	177	Inappropriate Response to UCP "RETURN TO PREVIOUS MENU" (Function Key F2) and Response Inconsistent With PUP
538	369	"HARDCOPY STOP" Function Not Available
539	274	Tolerances on P5 and P5U Voltage Appear to be Too Critical
540	275A	RPG Load Shed Messages are Not Stored at the PUP
541	287	Inconsistent PMI Requirements/Procedures for the RDA Halon Fire Suppression System Cylinder (UD1A8)
542	211	Inadequate Configuration Information on PUP Color Graphics Printer (UD47)
543	316	CPCI-28 Documentation Problems
544	025	Graphic Tablet's Protective Plastic Sheet Unsecure
545	450	PUP User's Manual Documentation of RPG Directory Mnemonics Incorrect

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
546	520	Inadequate "PRODUCT FORWARD" and "PRODUCT BACK" Functionality for Paired Alphanumeric (A/N) Products
547	436	Inconsistent Acronym for Standby on RDA Maintenance Terminal
548	085	Vertical Lines Occasionally Shown on Graphic Displays When Replaying Time Lapse
549	116	Maintenance Control Console Not Compatible with RDA Cable
550	089	Rear Mounting Holes for Small Computer System Interface (SCSI) Fan Assembly Misaligned
551	e524	Need for Capability of PUP to Calculate and Display Shear Between Operator Specified Points on Velocity Display
552	179	Inability to Automatically Display One-Time Request Products in Quarter Screen Mode
553	020	Inadequate Help Screen for Free Text Message Generation
554	171	Inadequate Small Computer System Interface (SCSI) Drive Assembly Bus Cable Clamp
555	235	Documentation for Cleaning/Replacing Generator Shelter Air Filters and Associated Functional Louvers Not Available
556	106	Rear Receiver Hinged Component Rack Interferes with Receiver Cabinet Maintenance Activities
557	037	Ladder Required in RDA Shelter
558	513	Error Messages Associated with Dial-up Request For Products with RADAR SITES, CITY, or COUNTY NAMES Maps
559	e091	Need for Capability to Position Graphic Tablet Anywhere on PUP Table
560	e024	Need for Cabinet Lighting
561	114	Radome Heater AC Power Cable Will Not Remain Connected to Output Power Box
562	e115	Need For Radome Heater Thermostat Control
563	e275	Need for Improved Backspace and Scrolling Capability at PUP Applications Terminal
564	172A	Entry of Storm Motion Parameters
565	074	"PRODUCTS IN PUP DATABASE" Screen Does Not Indicate How to Display or Delete a Listed Product
566	e241A	Inconsistent Use of Background Map Colors
567	465	Rain Water Leaking into Generator Shelter (UD10)
568	175	Response to "RETURN" Key When Editing UCP "SEND MESSAGE" Undocumented and Inconsistent With PUP
569	e219A	Display of Maxhum Value Location(s)
570	e181	Need for Time Lapse to Display Original Product Resolution at Display Rates Below One Frame Per Second
571	075	Glare on the Graphic Tablet Protective Plastic Sheet
572	108	Inadequate Documentation on Type and Size of Transmitter Focus Coil Air Filter
573	11i	Radome Cooling Fan Inlet Air Louvers Failed to Close When Fan is Off
574	063	Airport Locations on "AIRPORT" Background Map Changes at Different Magnifications
575	e409	Need for Hodograph Product Produced from VAD Winds
576	e321	Need for PUP to Identify Last Selected Routine Set (RPS) List
577	512	Misalignment of LFM Grid and RCM Intermediate Graphic Reflectivity Blocks

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
578	372	Preventive Maintenance Inspection (PMI) Procedures for PUP Audible Alert Operational Check Not Available
579	e318	Need for Matting on Interior Floor of All Radomes
580	205	"ARCHIVE MENU HELP SCREEN" Incorrectly References Megatape
581	e007	Need for Imoroved Metering Circuitry in RDA Transmitter (Tx)
582	100	Discrepancy Between Concurrent Small Computer System Interface (SCSI) Commercial Vendor Manual and PTM, Chapter 5
583	306	Relative Spacing of Product Annotation Text Characters and Special Symbols Altered After Magnification
584	041	Environmental Winds Edit Screen Data Format Inconsistent With Operational Upper Air Data Format
585	e227A	Need for Method to Select and Examine Titles of Adaptation Data Routine Product Set (RPS) Lists
586	428	Inadequate Separation Between Intermediate Graphic Display and Function Selection Areas on RCM Editing Screen
587	051	Optical Disk Drive Cartridge Ejection Too Forceful
588	160A	Incorrect Features on Velocity Azimuth Display (VAD) Products
589	e470	Need to Program Function Keys for Concurrent 3212 and 3280 Diagnostic Procedures
590	341	CPCI-03/CPCI-04 Shared Module Version Discrepancy
591	305	PUP Occasionally Displays Incorrect Background Map Resolution
592	339	Inaccurate Documentation of Adaptation Data Category 11, RPG Directory in PUP
593	213	Page Backward Command ("PAGB") Incorrectly Pages Forward
594	379	Transmitter Key Difficult to Remove
595	486	Undocumented, Non-Standard Bit Order for Raster Data Format
596	188	Small Computer System Interface (SCSI) Drive Assembly Rack Mount Guide Not Aligned
597	099B	Extraneous Radials of Data Shortly After Sunrise and Shortly Before Sunset
598	e161	Need for Improved Indication at PUP Applications Terminal When "USER FUNCTION MENU EDIT" Mode is Active
599	e270	Need for Method to Display in Color the Three Base Products at RDA
600	247	Inadequate Documentation of Automated Alert Notification Criteria
601	051A	Wavering Data on RDA Monitor
602	469	Hardcopy Capability Not Available When Running Ramtek Diagnostics
603	299	Inconsistent Documentation of PUP's Test Pattern #10
604	e021B	Need for Streamlined Procedures for Displaying the List of Available RPG Products
605	e364	Need for Automatic Selection of Clear-Air Mode
606	e456	Need for Minimum Threshold Value Displayed on Contour Products
607	143A	Latitude/Longitude Units
608	058	"BACKGROUND MAPS FOR PRODUCTS" Help Screen at the Unit Control Position (UCP) Not Available
609	e234	Need for Water Supply at RDA Site
610	330	"ARCHIVE MENU HELP SCREEN" Incorrect for Archive Background Maps Function
611	e046	Need for Display of Products in Quarter Screen Mode Using Graphic Auto Display Mode

List of Prioritized Category II Service Reports
Opened during IOT&E(2) or Revalidated from IOT&E(1A) and IOT&E(1B)

Rank	SR #	Title
612	398	Inconsistency Between VAD Product Times and Times Displayed Below Profiles Within the Product
613	e216	Need for Consistency Between UCP Archive Menu Options and Draft Federal Meteorological Handbook #11 (FMH #11)
614	e423	Need for Capability to Filter and Blink Data Levels of Product Overlays
615	188A	Need for Improved Graphics Display Editing
616	e174	Need for Consint Response to PUP and UCP Page Commands
617	e198	Need for Capability to Define Default Time Lapse Execution As Either Continuous Loop or One-Time Display
618	e425	Need for Overlay Product to Display Numeric Values of Rain Gauge Data
619	455	ALERT STATUS Screen Did Not Indicate How to Cancel Alerts
620	e242	Need for Product, Overlay, and Map Mnemonics to be Added to Graphic Tablet
621	133A	Nonmeteorological Azimuth Values
622	131	RDA Applications Terminal Monitor Has a Wavy Presentation
623	282	"WARNING AREA" Map Not Available
624	119	Nonstandard Depiction of 5 Knot Wind Barb on VAD Product
625	e233	Need for RDA Toilet Facility
626	e350	Need for Automatic Update Option for Status Screens
627	157	FMH-11: Inappropriate Requirement For "RANGE RING" Map to be Associated With Archive III or Non-Associated PUP Products
628	044	Electromagnetic Interference (EMI) Gasket Loose on Transmitter (Tx) Doors
629	e359	Need for Capability to Horizontally Magnify Cross-Section Products
630	322	Julian Date Conversion Incorrect After Year 1999
631	e365	Need for Higher Detailed POLAR GRID Map at Four and Eight Power Magnification
632	e146	Need for Reorientation of Vent Thermostats
633	e039	Need for Capability to Extrapolate the Highest Entered Environmental Wind Value Upwards to 70,000 feet
634	433	Missing County Boundaries on COUNTY Background Map in Northwestern Arkansas
635	142A	Misnamed Precipitation Mode
636	e152	FMH-11: Need for Reconsideration of Reflectivity Categories for Data Near Noise
637	e024B	Need for Relocation of Range Folding (RF) Color Scale Bar
638	e276	Need for Maps/Overlays Display Toggle Capability
639	e182	Need for Product Names on "OVERLAY ASSOCIATIONS EDIT SCREEN"
640	e385	Need for Echo Top Information in the Radar Coded Message (RCM) Intermediate Graphic Product
641	e345	Need to Relocate the "BACKGROUND MAP VERSION" Command to the "ADAPTATION DATA MENU"
642	e389	Need for the Ability to Independently Control Transmitter Intake and Exhaust Dampers
643	e086	Need for "Modify Line" Capability on "EXAMINE/EDIT USER FUNCTION" Edit Screen

APPENDIX D - ADDITIONAL RELIABILITY DATA

1. RDA: The RDA demonstrated the lowest reliability (MTBM (total corrective) of 53.1 hours) of the three functional areas and had the greatest impact on maintenance workload.

a. Of the 29 corrective maintenance events required at the RDA during Part B, 26 were for inherent malfunctions.

(1) Eleven of the inherent RDA malfunctions were transmitter problems. On six of these occasions, the preproduction transmitter was inoperative, indicating fault alarms such as "Focus Coil Failure" or "Mod Switch Failure" and system operation was restored after resetting the transmitter fault panel alarms; two of these occurred after a power interruption at the RDA site. Three actions involved hardware or LRU replacement: (1) replacement of a charging switch module, (2) replacement of a trigger amplifier module, and (3) replacement of two transmitter blower fuses. One action involved adjustment of the pulse forming network PFN voltage to alleviate a high transmitter peak power condition. The 11th action involved extensive transmitter alignments and Klystron tuning required to correct a high delta system calibration indication associated with a decrease in transmitter output power. The test team also had 19 transmitter maintenance actions during Part A of the test.

(2) Nine of the inherent RDA malfunctions were corrected by reinitializing the RDA software. Four were for corrective actions associated with clearing alarms (e.g., "Lin Channel Cal Constant Degraded," "Lin Channel Cal Check Indicates Maintenance Required," and "Radial Time Interval Error)." Two of the software reinitializations were required because the RDA maintenance terminal locked up and would not respond. Three of the reinitializations were required when the applications program stopped running; two of these occurred after a power interruption at the RDA site.

(3) Four other RDA maintenance actions involved LRU or hardware replacement. The antenna power monitor required replacement twice. The other two actions involved replacement of a power supply in the pedestal control unit and replacement of the filter in the transmitter air intake duct.

(4) One inherent RDA action required adjustment of the backup generator transfer delay time because the RDA site failed to transfer to backup power.

(5) The last inherent RDA malfunction occurred when an "Elevation Gearbox Oil Level Low" message occurred. Several cables and LRUs were replaced; however, the exact cause of the failure was never determined.

b. The one induced RDA maintenance action was associated with a defective post-charge regulator which occurred while replacing the defective charging switch module.

c. The two no-defect RDA maintenance actions were attributed to RDA alarms which cleared before maintenance could respond.

2. RPG: The RPG demonstrated the second lowest reliability (MTBM (total corrective) of 78.6 hours) of the functional areas.

a. Of the 23 corrective maintenance actions required at the RPG during Part B, 20 were for inherent malfunctions.

(1) The most significant problem was the failure of the RPG to recover automatically following power transitions; this occurred 12 times. Ten times system

operation was restored through a reset/restart of the RPG software. However, one outage required reloading the RPG software to correct the problem, and the other outage required a reconfiguration of the software interfaces.

(2) Seven other inherent RPG corrective maintenance actions required only a reset/restart of the RPG software to correct the problem. Three were associated with a disruption of narrowband communications, two were associated with wideband communications problems causing RPG discontinuity/loadsnedding messages or an unsolicited RDA disconnect, one was required to correct an Archive III problem, and one was required to restore operations when the RPG went down for unknown reasons.

(3) The two remaining inherent RPG malfunctions involved inoperative monitors at the unit control position (UCP). One monitor had to be replaced, and one was powered off/on to restore operations.

b. The remaining three RPG maintenance events were no-defect maintenance events. All three were "cannot duplicate" events. One involved a "RDA/RPG Communication Link Broken" message, but the system recovered automatically before maintenance responded. One involved an Archive III problem that was no longer evident when maintenance arrived. The remaining event involved narrowband line noise which maintenance personnel were unable to duplicate.

3. PUP: The PUP-demonstrated MTBM (total corrective) was 125.6 hours.

a. Of the 35 corrective maintenance actions required at the three operational PUP sites during Part B, 27 were for inherent malfunctions.

(1) The most significant problem was graphics lockups associated with the Ramtek graphics processor. Nine of the ten inherent malfunctions associated with the graphic processor were corrected by reseating the hard cursor card; one of these occurred after a power interruption. The 10th inherent malfunction was corrected through replacement of the PUP AC line filter and the replacement of the graphics interface card in both the Ramtek graphics processor and the Concurrent 3212 processor.

(2) The Archive IV optical disk drive unit required four maintenance actions due to inherent malfunctions. Three required adjusting or tightening the disk ejection lever because an optical disk was stuck or the drive would not activate. The fourth required removal and replacement of a failed optical disk drive unit.

(3) There were five additional maintenance actions required to replace failed LRUs. The LRUs replaced were the Concurrent 3212 processor multiple peripheral controller, a color monitor, an applications terminal monitor, a color printer, and a 1/4 inch streaming tape drive.

(4) Of the eight remaining maintenance actions associated with inherent PUP malfunctions, six involved conditions where the PUP was inoperable and system operation was restored by reinitializing the PUP software. One action involved reattaching terminals on wires in the PUP cabinet, and the final action required powering a monitor off/on to correct a system console blank screen.

b. Of the seven corrective maintenance actions required for induced PUP malfunctions, two were for switches or circuit breakers which were not set to the "on" position during power-up procedures. Two other actions involved the color printer: one for an incorrectly positioned media mode selector, and one when the print carriage was not properly locked in place. One action was the replacement of an applications terminal monitor which had not had a previous problem corrected before being reinstalled. One action was required to correct a display foldover problem on a recently replaced color monitor. The final corrective action for an induced PUP malfunction was attributed to a faulty optical disk.

c. There was only one no-defect PUP maintenance action. This involved an optical disk error message which maintenance personnel were unable to duplicate.

APPENDIX E - GLOSSARY

Archive I	The capability to store and retrieve analog time-domain data output from the receiver.
Archive II	The capability to store and retrieve digital base data and status information output from the signal processor.
Archive III	The capability to store and retrieve selected NEXRAD products and status information from the RPG. Archive III data may be read by Archive IV.
Archive IV	The capability to store and retrieve selected NEXRAD products, status information, and background maps from the PUP. The PUP training mode makes use of this capability.
Assess	Used to provide information about system capabilities without assigning ratings. This term applies when user requirements are not available or may not be appropriate for the phase of development; however, information is needed to support the user or the decision-making process.
Associated User	A PUP that is connected to an RPG using a dedicated communications line. Products and status information is automatically sent from the RPG to the PUP.
Base Products	Those products that represent fields of the three moments directly measured by NEXRAD (i.e., reflectivity, mean radial velocity, and spectrum width).
Capability	The percentage of DOD warnings that are both correct and provide the desired lead time.
Central Processing Unit	That part of the computer that interprets and executes instructions.
Critical Success Index	An index, used only by DOC, that is a measure of a forecaster's ability to forecast effectively and correctly.
Dealiasing	The process of assigning the correct velocity to Doppler-derived wind data. Wind velocities are determined by (Doppler) shifts in the received signal frequency from that transmitted. Data with incorrect velocities assigned are the result of not sampling at a high enough rate to determine the exact Doppler shift of the received frequency.
Derived Products	Those products generated within the RPG that represent either some combination of base products or a base product that has been enhanced or otherwise changed by the use of automatic processing techniques.
Did Not Meet Requirement	Level of performance was below the users' stated requirement.

Evaluate	Used to determine a system's ability to meet the users' stated requirements. Quantitative or qualitative methods of evaluation may be used. Ratings of "met" or "did not meet requirements" will be assigned.
False Alarm Rate	The percentage of incorrect warnings issued.
Met Requirements	Performance met or exceeded the users' stated requirements.
Narrowband	The communications link between the RPG and PUP that transmits NEXRAD products and status information via telephone lines.
Nonassociated User	A PUP that is connected to an RPG using dialup communications. Products must be individually requested from the RPG.
Nowcast	A combination of reports of current weather conditions in the local area and a short-term forecast for 3 to 6 hours.
Other Users	Other users of the NEXRAD system include federal government agencies other than the principal users; state and local government agencies; and private sector users such as airline companies, consulting meteorologists, news media, and universities.
PFI	Primary Fault Isolation (PFI) is a method of troubleshooting that makes use of PTM fault isolation flow charts, built-in test, indicators, displays, printed listings, and self-diagnostic internal logic, either as loadable diagnostic software or firmware.
Probability of Detection	The percentage of confirmed weather events covered by correct warnings.
Principal User	Operationally oriented agencies within DOC, DOD, and DOT which use weather radar information to perform or support their activities.
PUES	A Principal User External System (PUES) is an existing or planned principal user information network or other automated system with which one or more NEXRAD units must interface. PUES may interface with NEXRAD through either the RPG or PUP.
Range Folding	The placement of a single weather feature at multiple ranges from the radar. In order to resolve a large span of velocities, the radar must transmit at a high pulse repetition rate. Range folding occurs because the radar cannot determine if a returned signal was caused by the most recently transmitted pulse or earlier transmitted pulses.

Volume Scan	The continuous rotation of the antenna in azimuth while automatically adjusting the antenna elevation in discrete steps. During IOT&E(2), a volume scan took from 5 to 10 minutes depending on which volume scan was selected by the operator.
Wideband	The communications link between the RDA and RPG functional area that transmits NEXRAD base data, status information, and RDA control commands via fiber optics, microwave, or other communications media with a capacity greater than a telephone line (narrowband).

APPENDIX F - SELECTED OPERATOR QUESTIONNAIRE QUESTIONS

Primary MOE Questions that have Criteria.

Question Number	Primary MOE	Question
1	E-1-1	What was the overall effectiveness of NEXRAD as an aid for you in preparing accurate and timely weather warnings?
2	E-2-1	What was the impact on workload when you used only the NEXRAD PUP to perform existing agency requirements?
3	E-2-2	What was the impact on workload when you used the NEXRAD PUP and UCP to perform existing agency requirements?
4	E-4-1	What was the overall effectiveness of NEXRAD in providing requested products in a timely manner when you operated the unit in various weather scenarios at the representative maximum load? (Sterling, VA configuration)
5	E-5-1	What was the overall effectiveness of NEXRAD as an aid for you in preparing weather advisories?
6	E-6-1	What was the overall effectiveness of NEXRAD as an aid for you in preparing short-range forecasts? (0-6 hrs)
7	E-6-2	What was the overall effectiveness of NEXRAD as an aid for you in taking surface weather observations?
8	E-6-3	What was the overall effectiveness of NEXRAD as an aid for you in preparing and presenting weather briefings?
9	E-6-4	What was the effectiveness of NEXRAD as an aid for you in briefing traffic management on weather problems that could impact local traffic flow or local air traffic control capabilities?

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